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J. McMILLAN

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PACIFIC ELECTRIC RAILWAY INTERURBAN SYSTEM

By Rudolph W. Van Norden[1]

There are few places where Nature has gathered together so much for man's comfort and happiness and so little for his discontent or hardship as in the great and growing district surrounding the beautiful city of Los Angeles. Of her handiwork, there is bewildering variety, from mountains, bold, precipitous and picturesque, to valleys, broad, undulating and luxuriant in a riot of semi-tropical verdure, all to end abruptly in the limitless expanse of the blue Pacific with its gently sloping beaches interspersed with jagged bluffs and fantastic rock shores; the whole grouped to form panoramas to entrance the most prosaic mind. For the lover of outdoor life, Nature provides almost any climate desired, for the bracing air from the ocean is everpresent, any crop may be grown in the utmost profusion of quantity and of unsurpassed quality, and health or pleasure are always at command here, where the sun shines almost every day of the year, where the air is ever balmy and there are no winters.

That Los Angeles and the surrounding country is not only a great winter resort, but one of the greatest tourist centers in the world is well known, but few who have not lived there can appreciate the remarkable development which has taken place within a comparatively few years, or the highly efficient and modern institutions which have been provided for the convenience and comfort of native and visitor.

View of Echo Mountain and Pasadena From Mt. Lowe, Above the Clouds.

That the interurban system of electric railways centering in Los Angeles is the most perfect and complete in the world, is a statement often made by travelers of wide experience, and while there are many other well equipped and operated systems in the United States, it would be difficult to find the peer of the Pacific Electric, either in equipment or especially in method of operation. The motto, "speed, safety and comfort," is literally interpreted, while in equipment, the highest class of standard railway practice is followed. But the management and method of operation are, as in everything else, the ruling factors of success.

[1] Member Am. Inst. E. E., Am. Soc. C. E.

A Stretch of Main Line Parallelling the Huntington Drive.

Here the governing influence is like a happy family, all working as a harmonious whole for the maintenance of a system as perfect as genius and brains can accomplish.

The various departments are clear cut and well organized, many of the heads having been with the system since its inception. The whole is under the immediate supervision of the general manager, Mr. J. McMillan, to whose intimate knowledge of every movement in each department is largely due the remarkable harmony and high efficiency which has been reached in this system.

It would be hard to conceive of a more perfect distribution of routes to serve this territory of wonderful developments, than has been made in the building of this system, and yet, what is truly more remarkable, is the foresight of the designer, for the territory has been really developed as the result and following the completion of the various lines. Mr. Epes Randolph, who from 1900 to 1904 was first vice-president and general manager, laid his plans with the view of making the most complete and satisfactory interurban system in the world, by systematically creating the business to support it; and the care and judgment with which he carried out his desire and accomplished his purpose amid countless obstacles, is manifested in the results obtained and the acknowledgment and credit universally conceded.

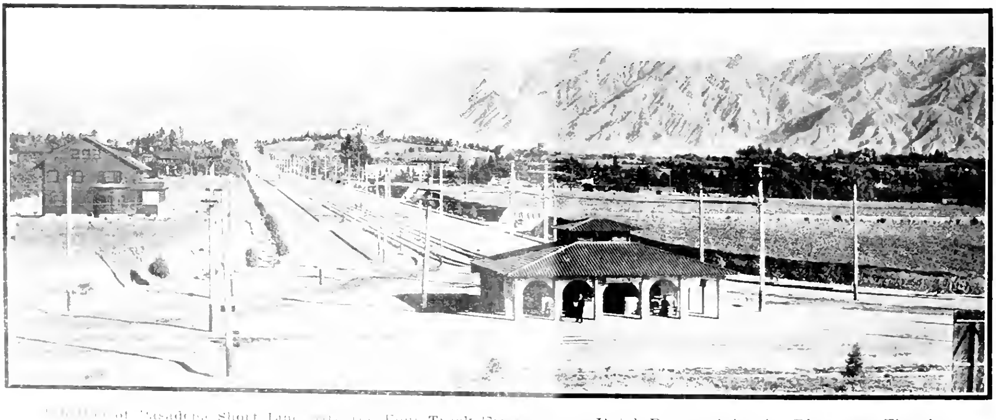
The interurban system is divided into two main divisions under which are operated all but three of the lines. Of these three, two are operated in connection with the Los Angeles City division and the third, the Mt. Lowe line, is operated in conjunction with the Pasadena City division. The total trackage is about 600 miles.

Each of the two main divisions, the Northern and Southern, are like great fans, or better, like a tree with its trunk and branches. The divisions meet and commence at the Pacific Electric building at Sixth and Main streets, in Los Angeles, and here is the main depot and the nucleus of the entire system, from which more trains are daily dispatched than from any five similar depots in the United States.

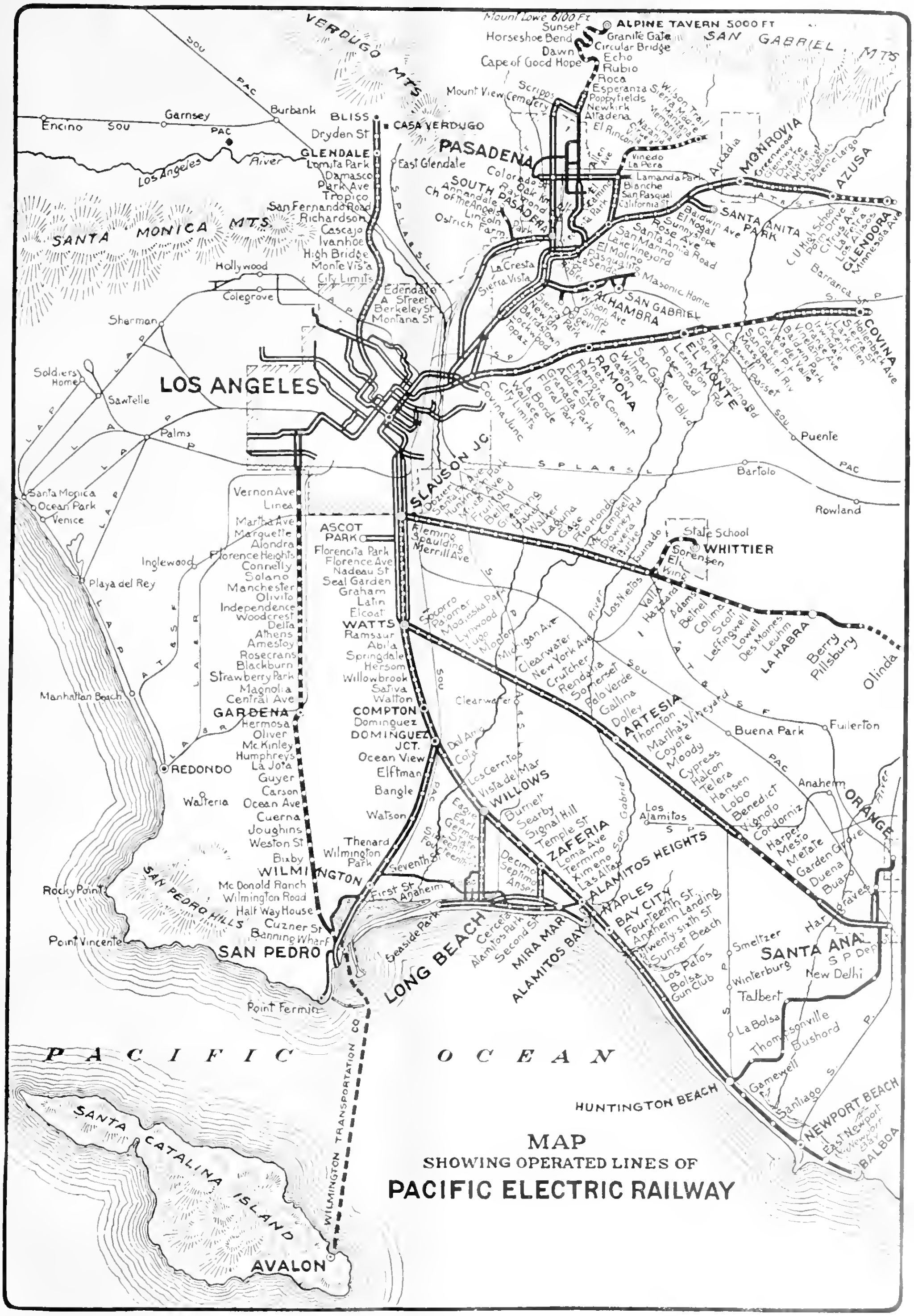
The Northern Division.

Trains on the Northern division, after leaving the depot, pass down Main street, through the business section of the city and, after crossing the Los Angeles river, take to the private right of way. This for a distance of three miles is double tracked as yet, due to the difficult route followed and the cost of construction, as it passes between hills and there were serious grades to overcome.

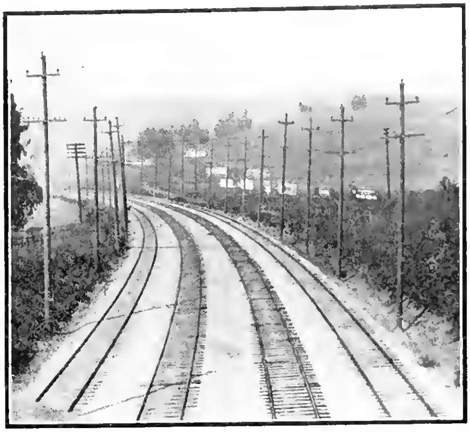
The right of way soon, however, spreads out and the four-track section commences near Eastlake Park, one of the many beautiful examples of landscape gardening, which show the possibilities of this section of California. At this point is also the junction of the Covina line The four-track trunk line extends northeast for a distance of 6.5 miles, paralleling one of the principal suburban drives, the Huntington boulevard. The perfect roadbed, the symmetrical alignment of track and poles and the neatness and finish of the whole are at once the pride of the people and one of the show places of the district. At a distance of 7.42 miles from Los Angeles, another, the San Gabriel branch, meets the trunk line from the south. At Oneonta the branch over which is the heaviest traffic of this division, the short line to Pasadena, meets the



[illegible] of Pasadena Short Line with the Four-Track Trunk Line. Hotel Raymond in the Distance. The San Gabriel Range and Mt. Lowe in the Center Background Showing the Cable Incline and the Summit of Echo Mountain.



MAP
SHOWING OPERATED LINES OF
PACIFIC ELECTRIC RAILWAY



Fine Example of Construction on Curve of Four-Track Line on the Northern Division.

trunk line. Still further, at Oak Knoll, a second line to Pasadena, passing through a recently settled district, leaves the main line and here is the terminus of the four tracks.

At a distance of 10.8 miles from Los Angeles the Sierra Madre line branches away from the continuing two-track line, which is known as the Glendora line.

Before the trunk line of the Northern division was built, there was in operation a third line between Los Angeles and Pasadena. This is now known as the "Old Line"; it turns to the north, leaving the present trunk line immediately after crossing the river and, following streets, reaches Pasadena by a somewhat devious course, passing en route the famous Ostrich Farm which almost everyone has seen or read about. From this line is a branch to Annandale, a suburb of beautiful homes. There is also a cross-country connection to the trunk line over which the Annandale cars operate.

The Pasadena short line was the solution of the problem of rapid and frequent traffic between Pasadena and Los Angeles, while the Oak Knoll line, almost as quick, passes through the terraced properties of luxurious homes.

Street Scene in Pasadena

Running east and west, just beyond the towns reached by these lines and abruptly rising in jagged pinnacles and precipices is the San Gabriel mountain range. Along its foot and among the foothills and spreading arroyas are nestled many picturesque towns and country residences. It is these places that are eventually reached by the various branches of the road, perhaps the most charming being Sierra Madre, at the foot of Mt. Wilson. The branch of the same name, after following gentle grades through orchards of countless fruit trees, passes through the town to the very foot of the government trail up Mt. Wilson.

The Glendora line parallels the mountain range, passing always through an everchanging panorama of orange groves, beautiful homes and prosperous towns, and back of it all the mountains furnish a setting in a countless variety of colors and effects to complete this fairy land of nature. The principal town through which this line is built is Monrovia, then there is Arcadia with its race track; Azusa, where is one of the power plants supplying this system and deriving its power from water gathered in the nearby mountains, and lastly Glendora. The most interesting feature, from an engineering standpoint, is the concrete arch bridge over the San Gabriel River, a description being given elsewhere.

The San Gabriel line passes through the pretty town of Alhambra to San Gabriel and eventually to the Masonic Home. San Gabriel, to many the most interesting spot on the whole system, is the site of the old mission, built in 1771 by the Spanish Padres under

Municipal Rock Crusher in San Dimas Canyon.

the leadership of Junipera Serra. The first settlement of the valley was at this point and the old mission church which has helped to make the charming romance of early California life, still remains in a good state of preservation, the joy of the native and wonderment and admiration of the visitor.

The branch to Covina takes an easterly direction, passing through much country which is as yet undeveloped. There are, however, a number of thriving towns, and wherever there are towns, one may see actually miles of orange orchards. This line is comparatively new, and has a section of single track about five miles long. As is the case throughout the system, the roadbed has been designed for double tracks and it will not be long before it will be so constructed in its entirety.

Oil Fields in the La Habra Valley.

At one point there is a long trestle crossing the San Gabriel River. To the casual observer the rivers in this normally dry country are a small factor in the landscape. But a storm in the mountains, such as is experienced on occasions during the winter months, may turn the dry arroya into a raging torrent, almost before one has had time to realize that a storm is on. Such was the action of the San Gabriel at one time, when, within one and a half hours, the water rose, leaving its bed for a new course a half mile to the east and took out 1000 feet of the roadbed fill. This was replaced by standard trestle so that there will be no danger of a repetition of the river's action.

The present terminus of this branch is at Covina, 23 miles from Los Angeles, but the road will be extended through San Dimas and eventually to Pomona. The road is now graded and finished past San Dimas and, through a spur, to the municipal rock crusher in the San Dimas canyon. Construction work on this section was expedited in order to get rock shipments.

Southern Division.

Trains for the Southern division pass through about a half mile of streets until the shops, car houses and freight yards are reached, when the private right of way is entered. This is the commencement of the four-track trunk from which the various diverting lines are taken.

The trunk, like that of the Northern division, is a magnificent example of electric railroad construction straight as an arrow for a distance of 7.45 miles. The poles on either side of the right of way are, in alignment, as perfect as the track, a condition unfortunately not always maintained in the average American interurban railway. On the pole tops on both sides are carried double three-phase transmission lines, which at present carry the entire power supply for the system.

The four-track section now terminates at Watts.

Street Scene, Santa Ana.

Main Trunk Line, Slausen Tower and Whittier Branch.

beyond which place the standard two-track construction is maintained. But this is soon to be changed and the four tracks will extend 5.86 miles further to Dominguez Junction, famous for its aviation field.

There are six feeders into the trunk line, respectively known as the Whittier, La Habra, Santa Ana, Newport, Long Beach and San Pedro harbor lines.

The Whittier line branches at Slauson Junction, a distance of 4.27 miles from the Los Angeles depot, and takes a southeasterly direction to Los Nietos Junction, whence it turns abruptly north, following a gentle grade into the city of Whittier. This is one of the beautiful towns reached, what was once an almost barren and desert waste is now a forest of citrus trees,

Heavy Cut on the La Habra Line

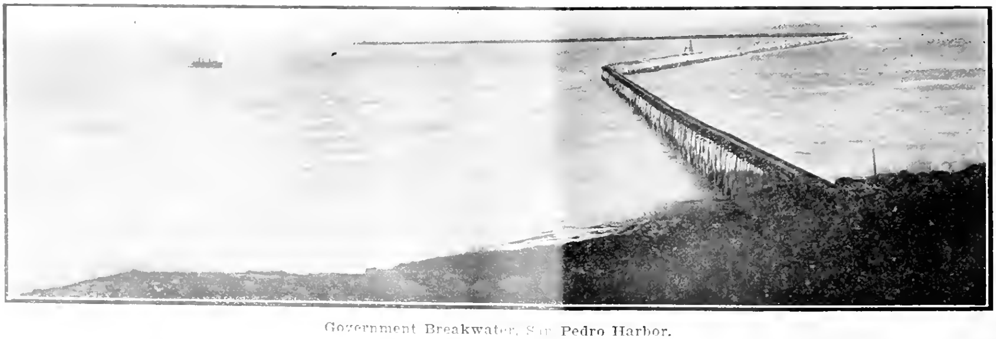
palms and other semi-tropical growths, every inch of the rich soil being made to bear in luxuriant affluence.

The La Habra line is a continuation of the Whittier line from Los Nietos Junction, and is one of the newest sections of the road. It maintains the southeasterly direction, paralleling a low range of hills which lay to the north and which separates La Habra valley from San Gabriel valley. The original appearance of the section traversed at many points is yet in evidence and a trip over this line is an object lesson, not only of the vast possibilities of this wonderful country, but of the manner of the building of this system, first to build the railroad to bring settlers and thus cultivate and enhance land values and in turn to furnish a rapid and frequent communication between these points and the city. Crude petroleum in great quantities is found in these hills, and, at many places, there can be seen literally forests of oil derricks, all industriously pumping their share of California's liquid gold from mother earth.

Four-Track Trunk Line of the Southern Division.

Newport Beach.

The line is constructed throughout for two tracks, but for the time being much of it is single. Building operations are constantly extending the terminus, which is at the present time at Yorba Linda in San Bernardino county, a distance from Los Angeles of 29.75 miles. The universal high grade of construction



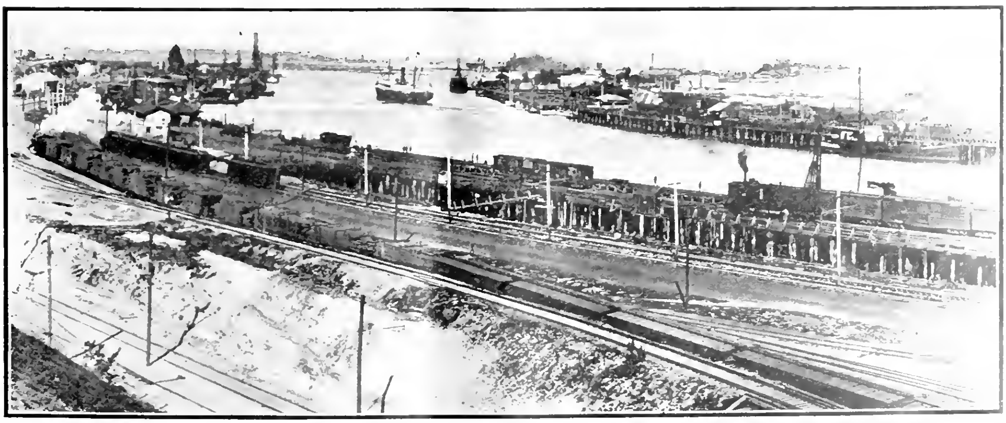
Government Breakwater, San Pedro Harbor.

An Afternoon Crowd at Long Beach.

is maintained throughout, particularly noticeable being the long tangents, or straight sections.

The diversion of the Santa Ana line is at Watts. This section pursues also a southeasterly direction, passing through a flat and extremely fertile country a distance of 34 miles to the city of Santa Ana. Santa Ana is one of the larger cities reached by the system and is a place of homes and well shaded streets, with a modern, well built business section, evidencing on every hand the high average wealth of the community. From Santa Ana the road continues in a southerly direction to the ocean, a distance of 13.31 miles, where it joins the Newport branch at Huntington Beach. This section of line passes through a great sugar beet country and the freight traffic, hauling sugar beets to the refinery at Delhi and for shipment to foreign roads, is heavy. A noticeable feature are the many spurs with their loading platforms and inclined approaches, under which the cars are placed and from which the farmers dump their wagon loads of sugar beets.

The Newport and Long Beach lines branch at Dominguez Junction and take a southeasterly direction. The former line meets the ocean at Naples, and from this point to the terminus at Balboa is a charming trip where the track is almost washed by the breakers and where attention is no sooner attracted by the modern hotels, pretty cottages and the gay crowds on the beach of one resort than one is whisked to another and yet another. The most interesting feature in the construction of this line is the method of oiling the roadbed, which is largely of sand, to prevent it from being blown away. The road passes along the constantly shifting sand dunes, one day the sand drifting high against the rails and another perhaps blown clear of the ties, with the caprice of the wind. The rails therefore have cast joints, the ballast is laid level with the rail top and the whole thoroughly oiled to form a compact mass. This not only prevents blowing away or washing away in rain storms, but also prevents drifting of sand between the rails. The principal places



Pacific Electric Terminal, San Pedro Harbor.

Avalon, Santa Catalina Island.

reached by this line are Naples, Anaheim Landing, Huntington Beach, Newport and Balboa.

The city of Long Beach, which is reached by a branch from the Newport line, is of recent and remarkable growth, the advent of the railroad having made possible this great playground. Like all of the other cities and suburbs, the streets are wide and clean, well shaded and lined with pretty and costly homes. The beach is, of course, the principal feature, and this, besides its long pier and the magnificent Hotel Virginia, is a maze of bath houses, restaurants and a thousand and one devices to amuse and entertain a pleasure-loving public. A fast 20-minute service between this place and Los Angeles is maintained throughout the year. The company also operates a service on the principal streets and there is a belt line to San Pedro.

The main line to San Pedro is a continuation of the trunk line. It enters a large freight and switching yard adjacent to the docks of the harbor, after crossing Wilmington bay on a trestle 1.5 miles long. The distance from Los Angeles to San Pedro is 22.68 miles.

San Pedro harbor is a "made" port, where, by the expenditure of many millions of dollars on the part of the United States Government and many more on the part of the people of Los Angeles, a great deep water

Hotel Virginia.

Long Trestle Across Wilmington Bay Near San Pedro.

Scene on the Glendale Line in the Hills North of Los Angeles.

harbor has been created. It is but one of the examples of the thrift and progressive spirit which universally prevails. And the city of Los Angeles by annexing a strip of land extending from the city proper to and including San Pedro and the harbor has made itself one of America's great seaport cities.

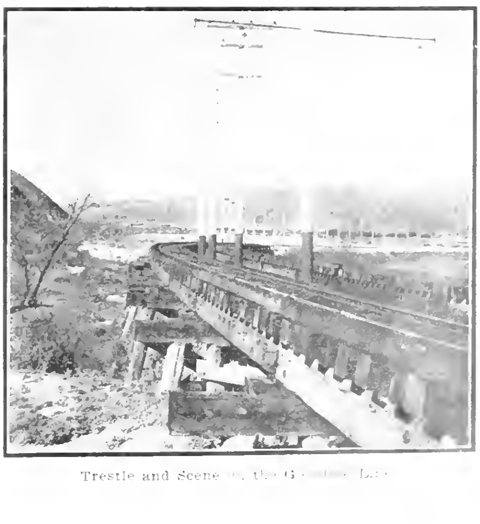
The passenger business to San Pedro is largely augmented by the boat connection at that point with Santa Catalina island, one of the loveliest all-year-round resorts in the world. This island is 30 miles off shore in the Pacific ocean, and is reached by regular steamers which leave upon the arrival of electric trains.

The City division will not be taken up in this article, except for the two interurban lines which are operated within its supervision. Trains for the Glendale line, after passing through the city, take a northerly course through the hills, north of the city, and crossing the San Fernando valley, through the growing and prosperous suburb of Glendale to the old Spanish hacienda of Casa Verdugo at the very base of the Verdugo mountains, a spur of the San Gabriel range. The remaining line is the "old" or Gardena narrow gauge, to San Pedro. This line after passing through the city, takes a southerly direction, passing through Gardena and a continuous stretch of fertile country and well-kept farms. This is one of the oldest lines of the system and will eventually be made to standard gauge. The cars of this line do not leave and arrive at the main depot at Los Angeles, as there is no provision there for narrow-gauge trains.

Mt. Lowe Line.

The Pasadena city section of the system includes the famous line up Mt. Lowe to Alpine Tavern. This

Pier at Long Beach.



Trestle and Scene on the Glendale Line.

enterprise was conceived and built by Prof. T. S. C. Lowe, who also built the astronomical observatory on Echo mountain. His plan was thought, at the time, to be a wild fancy, but he succeeded after many hardships in carrying out his ideas and the trip is always one of the first taken by the tourist.

The Pasadena system extends through Altadena and follows a winding course into Rubio Canyon, one of the many rugged and picturesque canyons of the San Gabriel range. In Rubio Canyon is a large depot platform and waiting room from which the world-famed inclined road takes a straight course up the canyon side to the crest of Echo mountain.

The length of the incline is 2581 ft., and the rise is 1238 ft. The slant with the horizontal averages 29 degrees, although at one point it is 32 degrees or 62 per cent. There are three rails with a passing switch at the middle point and two cars are operated together, being fastened to either end of a 1¼-in. cable, one going up as the other descends, passing each other at the switch. There is a stationary cable which lies under the center of each car and which may be gripped by an automatic device for safety.

"Ye Alpine Tavern" Terminus of Line on Mt. Lowe.

The operating house at the top of the incline, is a substantial concrete building containing platforms and waiting rooms for passengers who continue further. The cable operator sits in a tower where he can observe the upper part of the incline. Before him is a control board with instruments, rheostat and switches operating the motor which drives the cable, and also an ingenious device to indicate the exact position of the cars at any moment.

The operating mechanism in the basement of the building is driven by a 100-h.p., 500-volt, shunt, Westinghouse motor. It has both hand and band brakes and drives the large inclined cable wheel through spur and bevel gearing. This wheel is equipped with Halliday grips, which are a double set of steel fingers around the periphery, and which automatically grip the cable as it touches the rim of the wheel and loosen their hold when the cable leaves the wheel. No slipping is possible with this device. Mounted on the roof of the building is the great 60-in. General Electric searchlight, which, at the time it was built, was the largest and most powerful in existence and will be remembered for its famous service on the Manufacturers and Liberal Arts building at the World's Fair at Chicago in 1893.

From this point to the Alpine Tavern the road is of ordinary construction with trolley, the gauge being 3 ft. Many ingenious and difficult pieces of engineering are in evidence, especially the circular bridge which was necessary to gain a certain elevation and yet preserve the grade adopted.

All of the engineering work of the system is under the general supervision of the chief engineer, Mr. Geo. E. Pillsbury, who has been associated with the system since its inception.

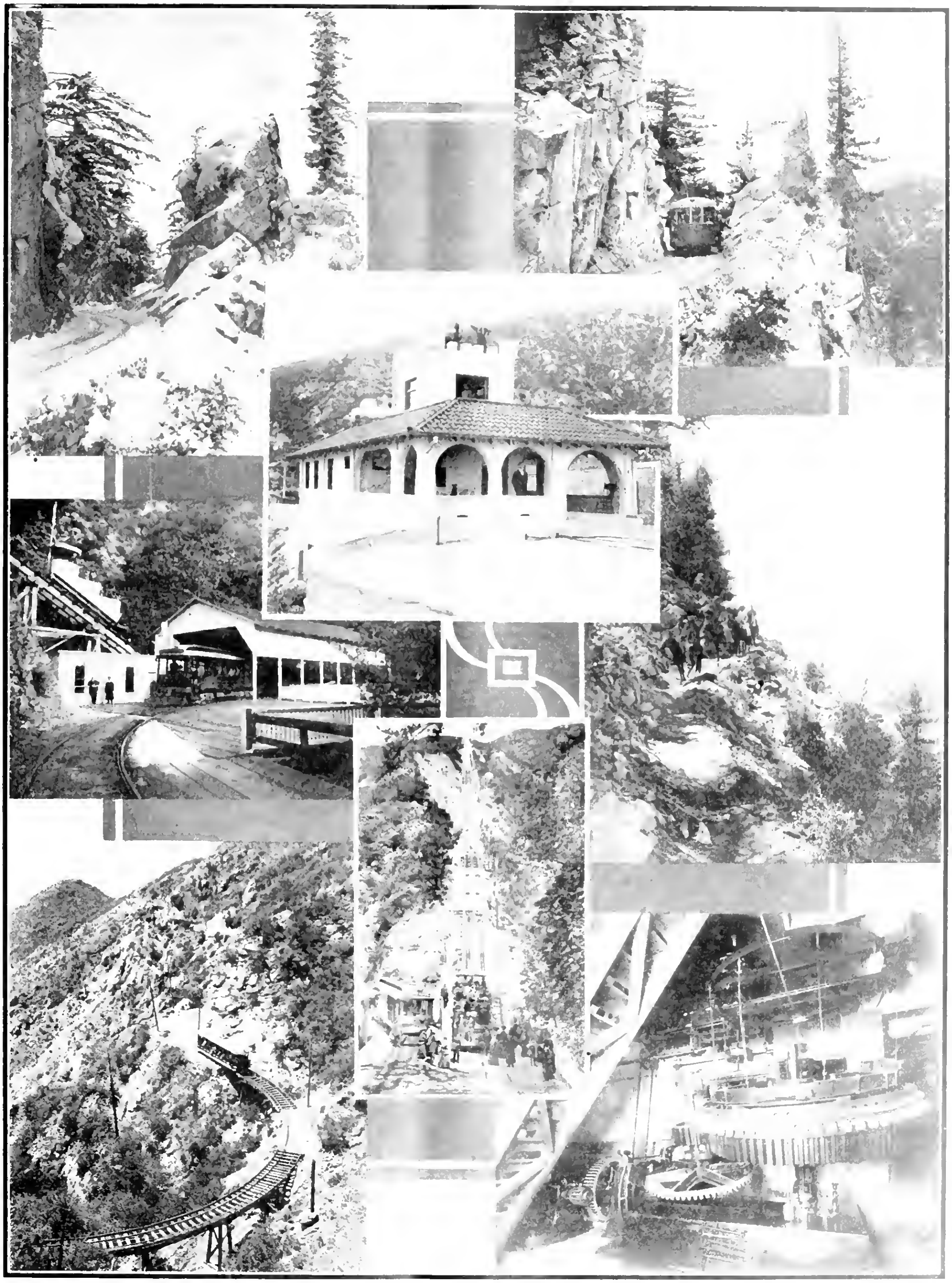
The ride from Echo mountain to the Alpine Tavern for scenic beauty and grandeur defies description. The passenger has before him a panorama over the San Gabriel and San Fernando valleys, the city of Pasadena at his feet, Los Angeles in the distance and yet further the broad expanse of the Pacific ocean. If the day be clear, as most days are in this land of sunshine, he can see Santa Catalina island and even San Clemente island, some 30 miles beyond. The distance from Echo mountain to the Alpine Tavern is 3.57 miles. In winter the passenger, in the space of an hour, may travel from Pasadena, where a frost is scarcely known, into snow and ice and at times above the clouds enveloping the valley, thus getting a variety of climate and scenery, within a short space of time, unheard of in any other locality.

Circular Bridge on Mt. Lowe Line.

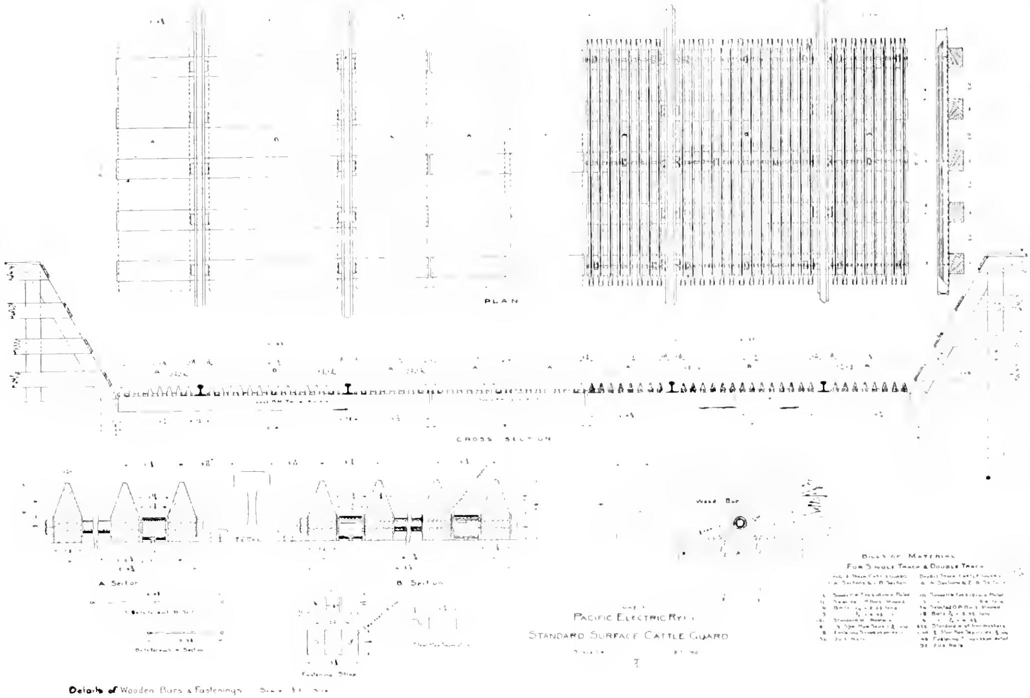
Track and Roadbed.

In the design and maintenance of the track and roadbed, standard American steam railway practice is followed. This company has, however, always made it a matter of policy to make all equipment and construction somewhat stronger and heavier than is called for in the service requirements. In other words, the element of lowest first cost is not strictly adhered to, as is unfortunately the case in many of our railroads, but on the contrary the least chance of interruption and therefore the highest class of work and materials is the principal aim.

The interurban lines are uniformly equipped with 70-lb., A. S. C. E. profile rails, although within cities and some towns, 6-in., 72-lb., Loraine section is used and also some 7¼-in., 87-lb. rail. Standard continuous rail joints are almost universally used, although on some lines, where the drifting of sand is often liable



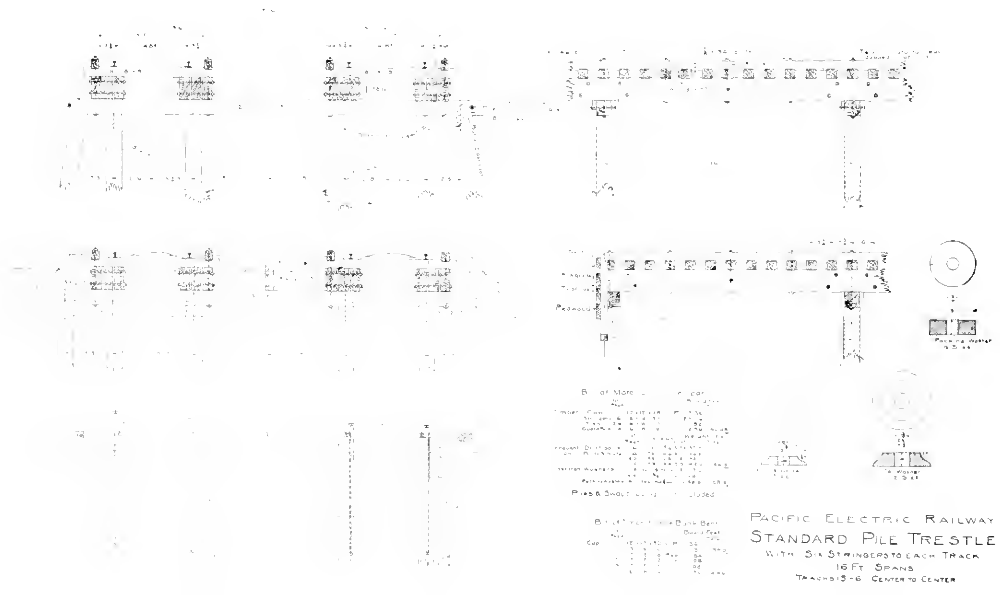
1 and 2. W[illegible] and S[illegible] Views [illegible]
3. Cable Operating H[illegible] Depot at [illegible] M[illegible]
4. Train Shed [illegible] Foot of [illegible]
5. On Trail From A[illegible] to the S[illegible] Mt. [illegible]
6. The Cable Incline [illegible] Mountain [illegible]
7. A Section of Line Be[illegible] Echo Mo[illegible]
8. Motor and Driving M[illegible]m of the [illegible]ne.



to cover the track, cast joints are employed. Switches, crossovers and turnouts follow standard steam practice.

The life of cross ties on different points of the system varies widely due to the nature of soils. At some points alkali deposits will rapidly decay the wood, and pine ties will not last more than two or three years at most, while redwood will remain intact for eight to ten years. Split redwood has been largely used for this reason. None of the ties are chemically treated before laying. The ties are 6 in. x 8 in. x 8 ft.

Gravel ballast is used to a great extent. This is easily procurable from the several gravel pits operated in connection with the system. On some of the lines,



where gravel is not so easily procured and where the roadbed is adobe, loam, or sand, oiling has been resorted to. This makes a compact ballast, prevents the formation of dust during the summer months and sheds water during the rainy season. On the Huntington Beach line, where sand during a hard blow from the ocean can quickly fill up the space between rails, the special precautions already described to prevent the ballast blowing away and the drifting of sand against the rails is employed.

The oil used is from the Sunset district and is known as Sunset road oil. It contains 75 to 80 per cent of asphalt. It is applied once a year from a special car. This car, an ordinary flat, is equipped with a sprinkler outfit from which the oil is distributed after having been heated by steam coils supplied from a small boiler also on the car. Where the distance is not too great, it is found to be more satisfactory to heat the oil from the steam supply at the car shops and then haul the sprinkler to the section to be treated. A road roller is also carried on the car, so arranged that it may be quickly run off at a road crossing or other place where rolling or quick finishing is necessary.

A standard simple cattle guard has been adopted, shown in the accompanying drawing, composed of strips of wood. Pit guards have been entirely done away with as being dangerous and causing more trouble than they avoided.

In all two-track work the centers are 15 ft. 6 in. apart; while on the four-track sections, the two outside tracks are placed with 13 ft. 6 in. centers to adjoining tracks.

Throughout the system, brazed bonds are used. They are 11 in. long and have an area of 300,000 cir. mils. The brazing is done by a bonding car furnished by the Electric Railway Improvement Company of Cleveland, O. This little car is equipped with a 30-kw. rotary-converter set which delivers alternating current at 370 volts to a transformer which in turn delivers a heavy current at a potential of 4 volts to the brazing electrodes or terminals.

Gravel Roadbed, La Habra Line

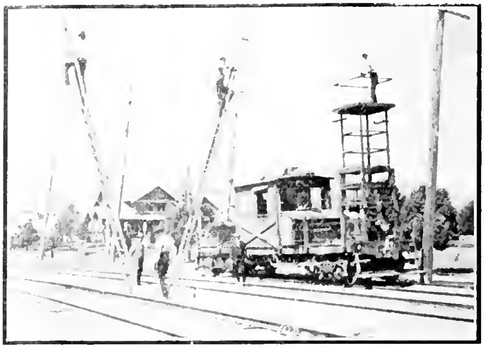
A standard form of trestle is used on all parts of the system where rivers, washes or ditches are crossed. This is well shown in the illustrations. As a rule 30 ft. piles are used and the average cost of double-track construction is $14 per ft.

There is, near Azusa on the Glendora line, a concrete trestle over the San Gabriel river, interesting on

Trestle on the Whittier-La Habra Line

Example of Oi[illegible]

Mexican Laborers Laying and Grading New Track at San Dimas.



Making Repairs to Trolley on Four-Track Line

account of its size. This trestle carries two tracks and is made up of a series of 18 arches, each having a span of 50 ft. The rise of the arch is 8 ft. 10 in., and the thickness at the crown is 22 in. The total length is 1025 ft., and the cost is estimated to have been $132 per ft.

Labor for the roadbed and right of way is done largely by Mexicans. These men are ignorant, as a rule, and must learn their duties from the ground up. They soon become proficient and take great interest in their work. Many of them own their tools and a Mexican, once he has earned enough to buy these, will care for them and guard them as jealously as he would his own child. They are eager and dependable and appreciate the universally good treatment accorded them by the company.

There are a number of large gravel pits on the Glendora line, one on the Sierra Madre line and one on the Covina line. There are five crusher plants at as many of the pits and in others steam shovels are used in loading cars. In the San Dimas canyon, about five miles back of the town of that name, is the large municipal crushing plant. An extension of the Covina line has been completed to this plant and it is estimated that about 50 cars of crushed rock for both municipal purposes and for public sale will be hauled out every day.

Where ditches and water courses are crossed, if they are small enough to require only a culvert and not a trestle, reinforced concrete pipe is laid through the embankment. This pipe is 24 in. and 30 in. diameter, as the requirement may be.

Overhead Construction.

The manner of supplying electric current to the cars of this system has been much discussed among

Electrically Operated Plant at [illegible] Showing T[illegible]dges and Switch-Operating Motors.

engineers. The overhead trolley was, however, definitely decided on early in its history, and if results are any criterion the wisdom and judgment of the engineers has been well justified.

While practically all lines are on private right of way, much of the trackage is within cities and towns, and where this is not the case, the numerous road crossings would break the continuity of a third-rail system.

Trolley construction has been well standardized in all details, which is undoubtedly one of the contributing causes to the maintenance of the superb alignment and uniformity, although this is more directly due to the close attention to details by the engineer in charge and the perfect understanding and system of intercommunication between the various departments maintained by the management.

A single pole construction has been adopted uniformly, except where four tracks are operated. The construction for single and double track is the same, as it is assumed that any stretch of single track will eventually be double tracked.

The poles are round Washington cedar, 40 ft. long, and are placed between the tracks, 7 ft. 9 in. from the center of either.

A simple pipe bracket of 1½-in. standard wrought iron pipe and 9 ft. long extends from either side of the pole, at a height of 21 ft. above the top of the rail. This bracket is braced by a 5/16-in. steel strand fastened between the pole and a malleable casting which terminates the pipe arm. The trolley insulator and wire is supported from a second 5/16-in. steel strand parallel to and underneath the pipe arm, fastened at one end to the pole, at the other to the malleable casting and supported at the middle from the arm.

The trolley wire is 000 standard grooved copper, there being about 400 miles of this wire in place. There has been a small amount, about 25 miles, of No. 000 figure eight wire in use. This latter proved unsatisfactory for high speed work. The lower part being heavier, the upper part would stretch, causing a bend or wave which would run along the wire to a flaw and then the wire would break. This wire has been replaced by 000 grooved phono-electric, which is now used for all new high speed work.

On curves the construction is the same and the poles are given a top offset up to 18 in., depending on the superelevation of the track. There are a few examples, on curves of short radius, where two lines of poles are used, set outside of the tracks, but this construction is avoided if possible.

Above the trolley brackets is a cross-arm which carries on one side two and in some cases four telephone wires. These are No. 12 copper and are used entirely for the operation of trains. On the other side the trolley feeders are carried. The top of the pole invariably carries one and, in a few sections, two three-wire copper circuits for the 15,000-volt substation distribution.

On the two four-track sections, two lines of poles are set on either side, outside of the tracks. These poles are nearly all 50 ft. long and are given a top offset of 3 ft. The trolley wires are supported in the ordinary manner, but in order to hold the two inside trolleys in line with the others an auxiliary wire is fastened to the main support wire in such a manner that the strain at the center of the latter is carried by the former. There is also fastened from pole to pole, on curves, a messenger wire and from this is stretched across the tracks, additional trolley wire supports. This system insures the trolley wires from displacement and undue vibration where high train speeds are maintained.

The poles on tangents on both the two and four-track construction are spaced about 110 ft. apart. On curves on the four-track lines, the inside line of poles are spaced 95 ft., while the outside line are spaced 50 ft. apart.

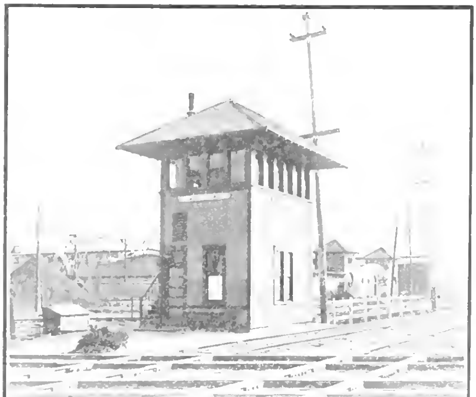
Pole-Setting Specification.

	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
B	2⅛	4¼	6⅜	8½	10⅝	12¾	14⅞	17	19⅛	21¼	23⅜	25½
C	2⅛	4¼	6⅜	8½	10⅝	12¾	14⅞	17	19⅛	21¼	23⅜	25½
D	1½	3	4½	6	7½	9	10½	12	13½	15	16½	18
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
E	11 6½	11 7	11 7½	11 8	11 8½	11 9	11 9½	11 10	11 10½	11 11	11 11½	12 0
F	10 5½	10 5	10 4½	10 4	10 3½	10 3	10 2½	10 2	10 1½	10 1	10 ½	10 0

A—Superelevation.
B—Offset of trolley.
C—Rake of pole, single pole construction.
D—Offset of pole, single pole construction.
E and F—Dimensions for framing pipe arms for curves.

Signal System and Interlocking Plants.

The extensive signal equipment in use and to be installed is a necessary adjunct towards the safety and rapidity of movement of the unusually heavy traffic handled. The system is operated by a department for that exclusive service under the supervision of Mr. A. E. Roome. As before stated, dispatching trains and



[illegible] Tower at M[illegible]

communication between the main depot and every part of the system is by telephone.

All block signal and station semaphores are manually operated by the station attendants. At crossing points with steam railroads, signal towers are maintained which are either manually or electrically operated. By this means absolute safety at crossings is assured and, at the same time, high speeds are maintained, which, were it not for these towers, would make frequent and rapid schedules impossible.

An automatic electric block system is to be installed on the four-track trunk lines of the N[illegible]

(Courtesy of Electric Traction Weekly.)
Interlocking Plant at Dominguez Junction, Substation on the Right.

division. This is deemed necessary, due to the heavy traffic, as trains are not allowed to run closer than one-half mile and there is little leeway in maintaining

(Courtesy of Electric Traction Weekly.)
Interior of Slausen Tower, Showing Levers and Interlockers.

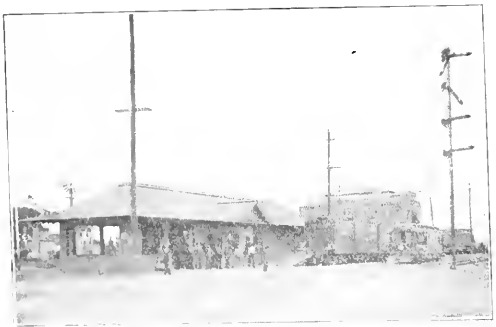
this distance where trains during parts of the day pass a given point at intervals of 45 seconds.

Two of the interlocking junction towers, established several years ago, are mechanically operated, the equipment having been furnished by the Union Switch & Signal Company. One is at Dominguez Junction, where the Long Beach and Newport lines leave the trunk, and the line to San Pedro at the crossing with the Southern Pacific Railway. It is, like all of the towers, a two-story frame building, 12 ft. by 12 ft., and follows a standard design. There are 175 regular electric and 12 steam trains handled daily. The operating levers on the second floor are 28 in number.

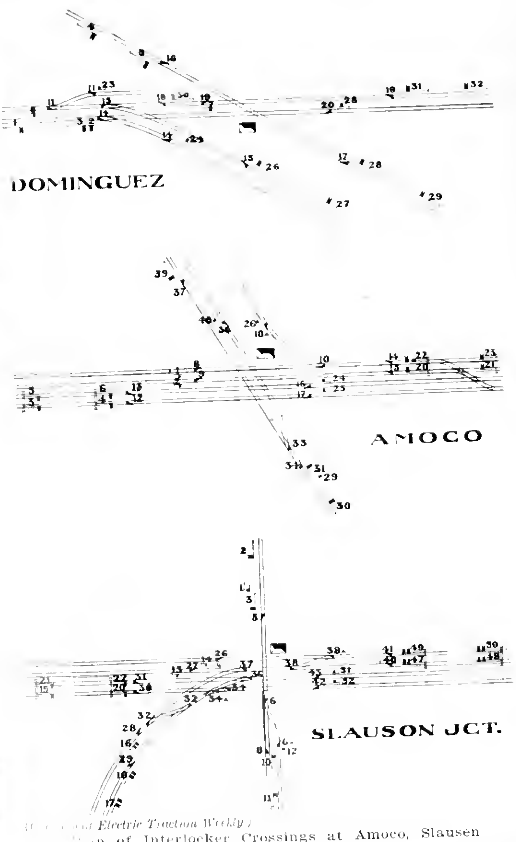
The other mechanical plant is at Oneonta Junction. This plant is similar in equipment with the Dominguez plant and handles 185 electric and 12 steam trains daily.

The electrically operated towers have been recently installed and were furnished by the General Railway Signal Company. There are at present two in operation, although three more are under contemplation. These towers are at Amoco Junction, where the Southern Pacific Railway crosses the four-track trunk of the Southern division, and at Slauson Junction, where the Santa Fe Railway also crosses the four-track line. The Whittier and La Habra line also joins the trunk lines at this latter point.

These towers are interesting from the fact that they not only represent modern practice, but also on



(Courtesy of Electric Traction Weekly.)
Station Semaphore at Watts.



(... of Electric Traction Weekly.)
...an of Interlocker Crossings at Amoco, Slausen Junction and Dominguez.

account of the great number of train movements which they control. The Amoco tower is equipped with 40 and the Slauson with 50 levers. The latter tower is the most intricate and has the greatest number of train movements. It handles 288 through and 172 local electric, regular passenger and 12 steam trains daily. The average number of movements per day is 1840.

In the first floor of the towers are the storage batteries for operating the motors which actuate the various signals and switches. On the upper floor are the operating levers, interlocking cabinet and the switchboard. At the Slauson plant, there are 9 swich operating levers, 13 on the derailers, 14 which operate 19 high signals and 7 operating dwarf signals.

Four lever movements are made in passing a train. Both home and distant signals are mounted on bridges, the signals being over the centers of the respective tracks. The distant signals are 1200 ft. while the others are 500 ft. from the tower; the derailing switches are 55 ft. beyond the home signals. The operator's first lever movement closes the derailing switch, the second locks this switch, the third movement clears the home signal and the fourth clears the distant signal, which also locks all conflicting tracks and locks their derailers open.

The movements of all switches and signals are actuated by motors, one being required for each movement. The switch motors are in cast iron housings at the side of the track, while those for the semaphores are in the base of the tower or on the bridge, as the case may be.

The storage battery in the base of the tower consists of 55 chloride cells, having a capacity of 80

Form #56—5M—5-09

Pacific Electric Railway Co.

REPORT OF CONDITION OF INTERLOCKING PLANT

Name of Plant Oneonta Tower

Initials of Foreign Roads (if any) S. P.

Date 1-31 1909 Time Covered by Report 6 P.M. T. 6 P.M.

The following questions must be answered by erasing "Yes" for a negative and "No" for an affirmative reply. All defects in plant, delays to trains, disregard of rules or other irregularities must be reported fully under "Remarks" and by letter accompanying report if necessary.

1. Did you read Report of Signalman relieved by you and understand condition of plant before going on duty?	Yes ~~No~~	7. Are all Signals properly adjusted for both positions?	~~Yes~~ No
2. Is there any evidence of looseness or failure in machine or locking?	No ~~Yes~~	8. Are all Signal glasses and lenses clean and uninjured?	~~Yes~~ No
3. Is there any evidence of looseness or failure in lead out or outside connections?	No ~~Yes~~	9. Have any Signal lamps gone out during the night?	~~No~~ Yes
4. Are any Crank, Compensator, Wheel, or other foundations loose?	No ~~Yes~~	10. Are all electric attachments working properly? (If any	~~Yes~~ No
5. Do all switches and derails lock properly?	Yes ~~No~~	11. Has there been any disregard of the rules by trainmen or others	No ~~Yes~~
6. Are all detector bars working and in good adjustment for both positions?	Yes ~~No~~	12. Have any trains been delayed?	No ~~Yes~~

Date of last inspection by Signal Maintainer 1-28-09

Date of last inspection by Foreign Road (if any) 1-28-09

REMARKS

Lock #31 went out of order at 6 P.M. also distant signal north bound main line failed to come back to position.

Correct C C Dodge Day ~~Night~~ Signalman J. Dinwiddie

Received Report 6 30 P.M. Defects Repaired 7 05 A.M.

J. A. Barham Signal Maintainer

While on duty each day and night Signalman must carefully inspect plant and at the end of each shift fill out two of these Reports, show them to the man relieving him who will note any effects before taking charge, and then mail one to Superintendent of Division and one to Signal Engineer by first train

(*Courtesy of Electric Traction Weekly.*)

Report of Condition of Interlocking Plant

Automatic Crossing Flagman

ampere hours. The maximum charging current is 10 amperes which is taken from the trolley after passing through a suitable resistance. Ordinarily the battery is floating on the supply current and there is a continuous charge of about 2 amperes. The cost of charging per month is insignificant, amounting to about $1.50.

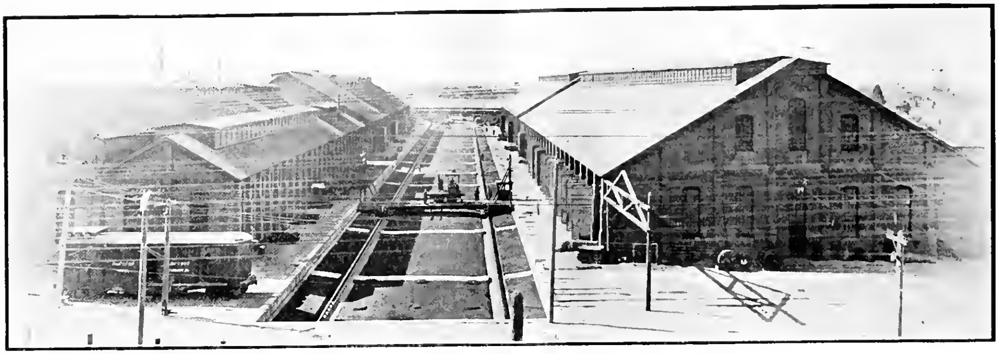
The interlocking control is so arranged that it is impossible for the operator to make a false move and permit two trains to approach a crossing at the same time. The bed on the surface of the machine is intricate, being composed of 2593 pieces.

All lines and apparatus are amply protected by lightning arresters and fuses. Four 1-c.p., 27½-volt lamps are placed in each signal circuit, one of them being a pilot lamp in the tower, while the other three are in the signal. Mounted in front of the signal lamps are lenses which make the light visible for 2 miles.

The lights and power operations are governed from a switchboard, by 30 switches, and it is equipped with voltmeters, ammeters and ground detectors, also the pilot light for each circuit.

The slightest derangement of the switches or circuits will block operation and should a switch point be jarred or pried open a small fraction of an inch the signals will not clear until the fault is remedied.

A most thorough and careful system of inspection is followed; this is made by both signalmen at the end of their shifts, who fill out a report form in duplicate noting any defects or irregularities and is signed by both men. These are immediately sent to the division superintendent and the signal engineer. Inspection is made once a week by the foreman of the department and every other week by the superintendent, while every 30 days the inspector of the steam road at the point in question is called in for a joint inspection.



Car Shops at Los Angeles.

Swinging Signals.

A novelty which this system has recently placed in use, and will be installed at all road crossings, is a moving signal or automatic flagman. This signal, seen in the illustration, consists of the familiar continuous striking gong, but mounted above the gong is a forked arm, standing when at rest in a vertical position. This arm is swung from its middle on trunnions; at the top is a large hollow disc, painted so as to be conspicuous, the center of the disc having on both sides a circular opening, and within the disc is a red electric light; while at the bottom is a weight acting as a pendulum. Upon the approach of a train, the signal actuated through track contact commences to swing, the disc moving back and forth while the gong rings in unison with the movement, the light in the disc shows and a series of five lamps also lights, illuminating the crossing. Current from the trolley lights the lamps and also after passing through a resistance operates a 1/12-h.p. motor which actuates the swinging arm.

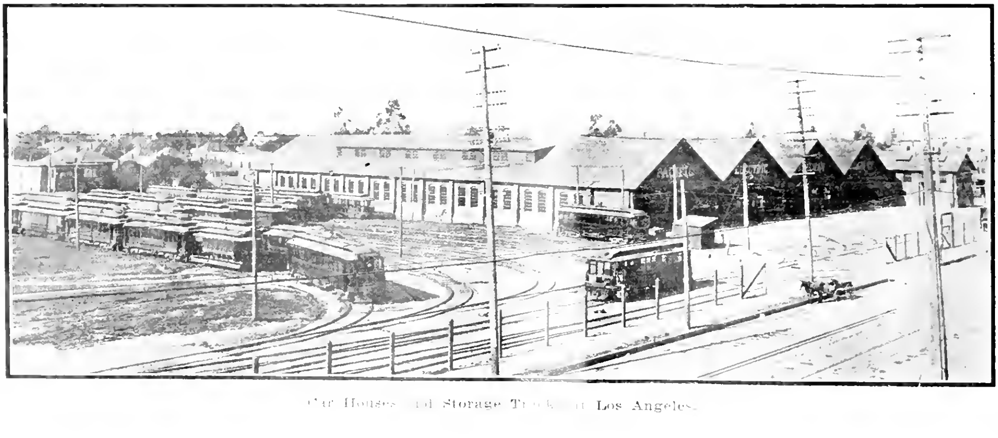
There will be several additional electric interlocking towers at steam railroad crossings. A new electric interlocking tower is under process of construction where the Pasadena short line leaves the four-track trunk, at Oneonta Park. This will be equal in size to the Slauson tower.

Car Houses and Shops.

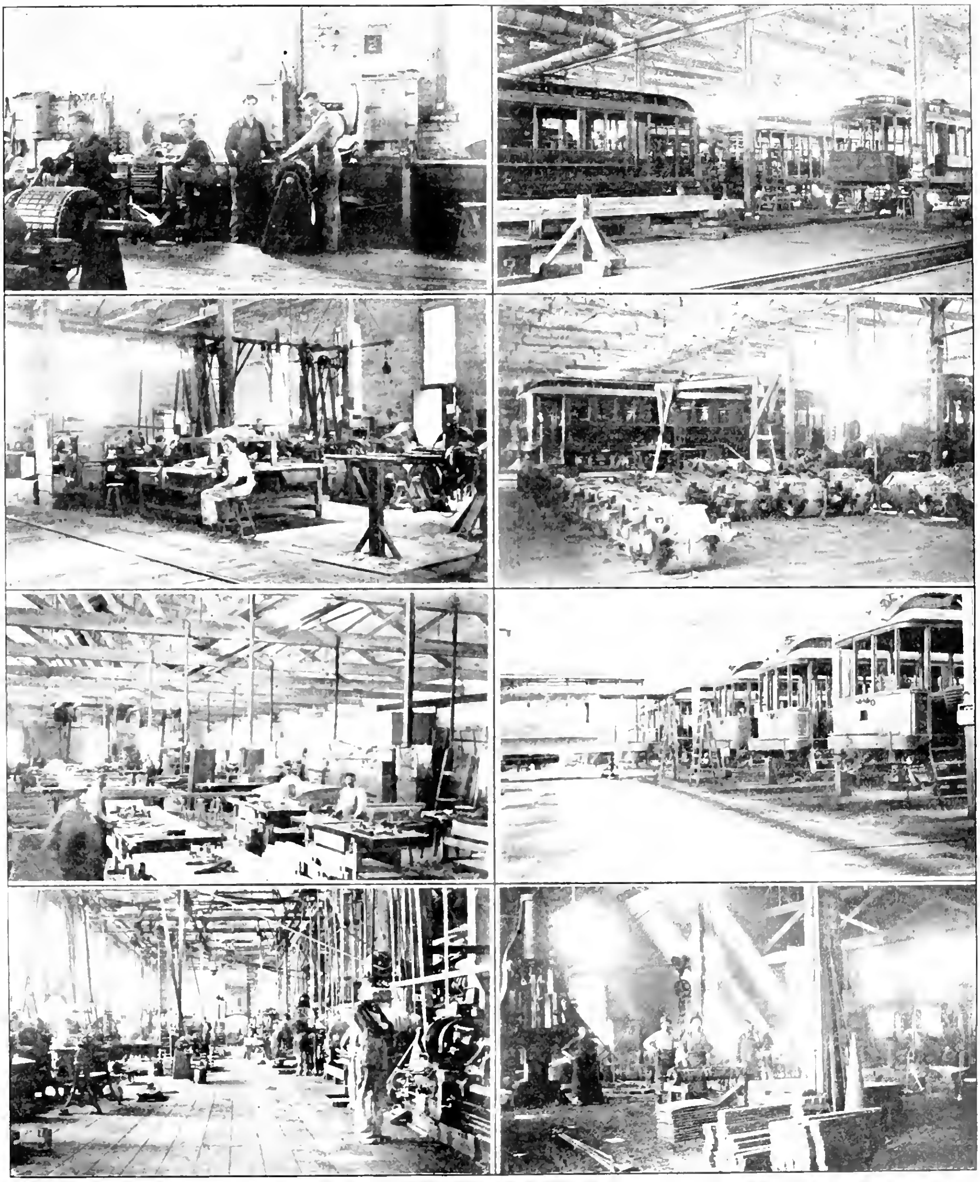
At Los Angeles, close to the car shops, are the main car houses. Most of the interurban cars are stored here, the buildings having a capacity for 100 cars. The illustration gives a good idea of the size and capacity. At Pasadena are two car houses, both of them substantial brick structures. One of these is in the building of the old steam plant, now abandoned, but recently converted into a substation. It is used to store interurban cars. The other is larger and used for city cars. At Long Beach is a new substantial brick car house with a capacity for 25 cars.

This company has not, for various reasons, built any of its new car bodies. The repairing and reconstruction of cars is, however, a necessary adjunct and this work is done by the mechanical engineering department, of which Mr. F. F. Small is superintendent, in the extensive and well equipped shops at Los Angeles.

These shops are arranged in two principal rows between which is a transfer table operating the entire length. One feature of the environment that is forcibly impressed upon the casual observer, a feature which is consistently carried out with the system, is the neat and cleanly appearance, both within and without the buildings, the absence of junk piles and the air of cheerfulness imparted by the lawn and terraces within the transfer runway.



Car Houses and Storage Tracks at Los Angeles.



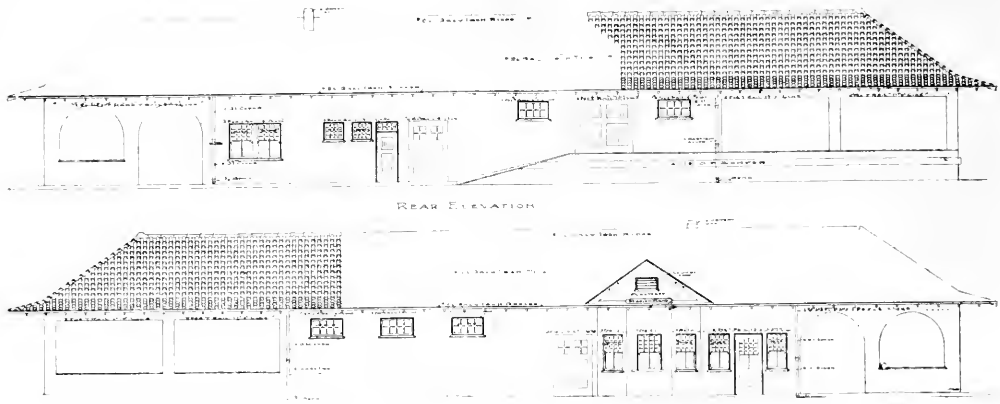
Views in Car Shops. 1—Winding Armatures. 2—Car Repair Shop. 3—Forming Armature Coils. 4—Overhauled Motors Ready for Mounting. 5—Cabinet Shop. 6—Paint Shop. 7—Machine Shop. 8—Forge Shop.

Within the buildings on the right of the view shown are the general repair and assembly departments. On the left is a well equipped machine shop with motor driven tools. To the rear of this shop is the forge shop. Beyond is the paint shop and adjacent to it the storeroom building over which is the cabinet and carpenter shop.

Many parts of the rolling stock equipment have been designed and built here and these designs have been adopted as standard for the system. This is true of car trucks, of which a number of styles are built depending upon the equipment.

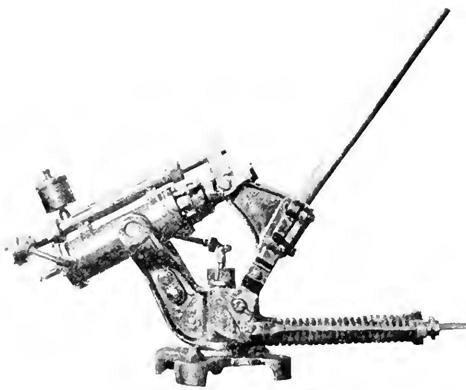
One of the most interesting departments is the motor and armature winding shop. Here all work of this nature is carefully and thoroughly accomplished.

The Greenameyer pneumatic trolley used on all cars, and now in more or less general use, was [illegible] vented and designed in these shops [illegible] It displaces the various spring arrangements [illegible] elsewhere and is actuated by compressed air [illegible]



Elevations of Standard Depot.

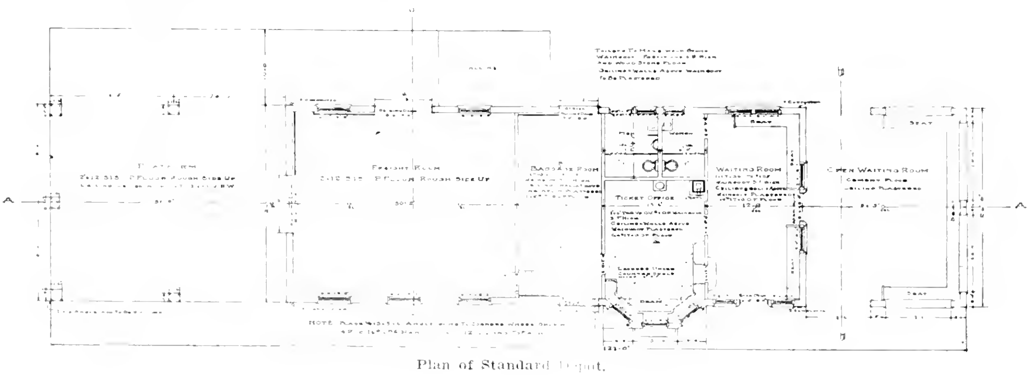
car reservoir. The base of the trolley pole is pivoted and the pole tends to assume a vertical position through the strain of a spiral spring actuating the bell crank at its lower end. Two cylinders mounted together and supported on trunnions serve to control the motion of the trolley should it leave the wire. The plungers in these cylinders also connected together are pivoted to a cast arm on the pole. Air is brought through the swivel base to the lower end of the large cylinder, thus assisting in maintaining the strain against the wire. Should the trolley wheel leave the wire, the sudden movement of the pistons causes a charge of oil in the smaller cylinder to throw a valve, allowing the oil to enter the large cylinder under the plunger and shifting the air pressure to the other end of the cylinder, the whole acting as a dash pot and eventually bringing the pole to rest without having raised to any great extent. The trolley wheel used is the standard 6-in., "Kalamazoo" wheel.



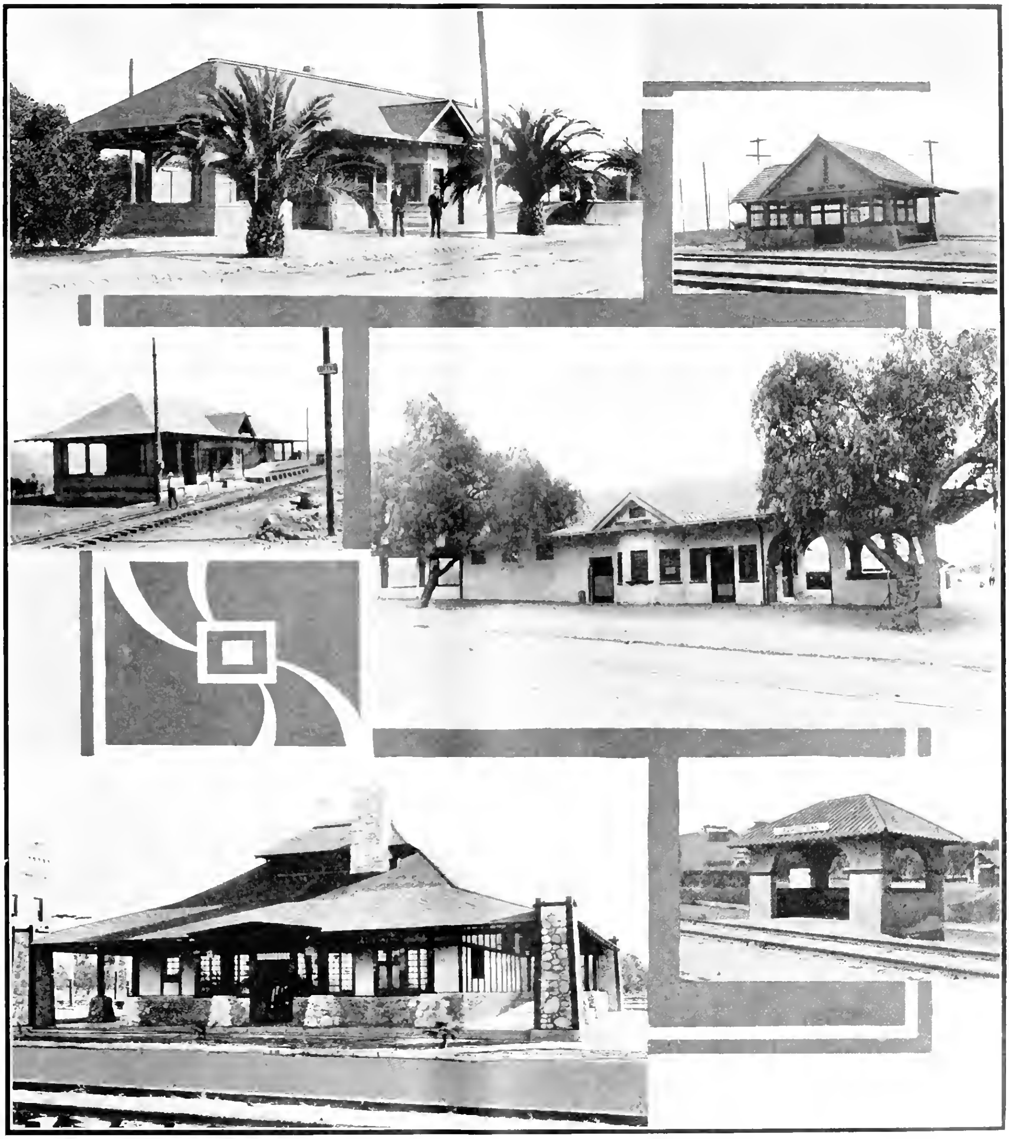
Greenameyer Pneumatic Trolley.

Another interesting piece of apparatus built here is a trolley cross-over. This was designed for rapid service where the jumping of the trolley from the wire would cause a delay which could not be permitted and also possible damage. It is used particularly where one trolley wire crosses another at an acute angle, as, for instance, at Slanson Junction, where the Whittier line leaves the main trunk lines and crosses the inbound outer or local track.

Trolley Frog or Crossover.



Plan of Standard Depot.



Various Types of Pacific Electric Depots and Shelter Stations.

Depots and Buildings.

Throughout the system depots or shelter stations are provided not only at all towns but wherever the passenger or freight traffic warrants the outlay. In all towns the depots are similar to those required in good steam railroad practice and follow two distinct types in appearance and arrangement. One type is for a frame structure while the other is concrete. They are conveniently equipped with open and closed waiting rooms, ticket office, baggage and express rooms, freight house and platform. Careful attention is paid to artistic surroundings and general appearance and well trimmed lawns, shrubs and trees are almost invariably in evidence.

The frame buildings are covered with shingled roofs. The concrete buildings have solid walls and metal tile roofs. The average cost of building these depots is $4500 for the frame construction and $6000 for the concrete.

There are many shelter stations in almost as many varieties of architecture. They vary greatly in size and cost. The reason for this is, that many of them are built by citizens or real estate companies often times before the anticipated population would justify

Freight Depot, Los Angeles.

the railroad company in the cost of a station. In many cases the community has furnished lumber and all materials while the railroad has supplied the labor for construction.

(Courtesy of Electric Traction Weekly)
Entrance to Train Shed, Los Angeles Depot.

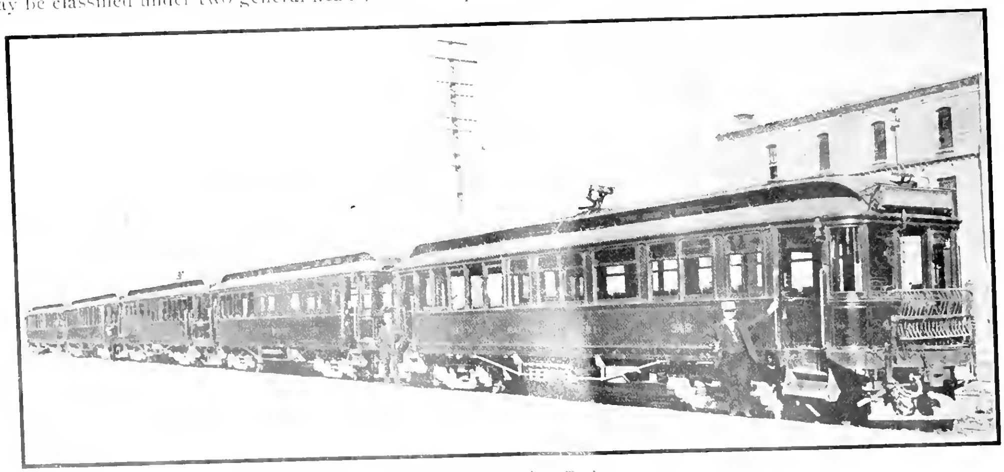
Rolling Stock.

The rolling stock of this system, except freight cars and flats, are almost all motor cars for the various uses. In the interurban passenger service, the cars may be classified under two general heads, the 200-h.p. and the 300-h.p. equipments. There are a variety of sizes and styles of motors as well as brake systems and trucks. All interurban cars have, however, the same general appearance.

All cars are painted red, or to be more explicit, crimson. A noticeable feature of the vestibules is that the corners are rounded, giving a neat and substantial appearance. The interurban cars are divided about two-thirds of their length by a partition with a door, this section being permanently enclosed. At the other end is also a partition with a door opening on to the vestibule.

The open end has no partition and is open to the vestibule. From the exterior, the appearance of the window openings are all alike, giving the effect of an ordinary closed coach, except that there are no sashes in the open section. The seats in the enclosed part are upholstered in red plush and are of various modern patented styles; in the open section the seats are of wood. The motorman sits in the center and at the open end is protected from being jammed by people entering or leaving the car by a nickeled pipe railing. The interiors are finished in mahogany with veneered ceilings.

An arc headlight is placed about 6 ft. above the level of the track and covered with a wire gauze screen on which is mounted an asbestos plate, having at the center a hole 3 in. in diameter. This concentrates the light on the track and prevents the blinding of persons



Typical Interurban Train.

approaching on the street or the motormen of cars running in the opposite direction.

Motor and brake equipments have, in nearly all cases, been furnished by the Westinghouse Company, although there are a few General Electric equipments on some of the smaller cars. The Westinghouse pneumatic multiple unit control is used for interurban work and all of the newer cars are so equipped.

Following is a complete list of all rolling stock in use on the road:

PASSENGER CARS.	Total.
Observation Cars	7
Inspection Car	1
Passenger Motor Cars	367
Passenger Non-Motor Control Cars	18
Passenger Trailer Cars	2
Passenger Motor Cars at Mt. Lowe	3
Passenger Motor Cars at Riverside	15
Passenger Trailer Cars at Riverside	2
Incline Cable Cars at Mt. Lowe Incline	2
Horse Cars	2
Total	419
COMBINATION CARS.	
Passenger and Express Motor Cars	9
Passenger and Express Trailer Cars	1
Passenger and Mail Motor Cars	4
Total	14
Express Freight Motor Cars	20
Motor Wrecker Cars	2
Motor Tower Cars	4
Motor Power Cars (1 PE. Motor Power Cars at Riverside)	18
Electric Locomotives	4
Steam Locomotive for Construction Work	1
Portable Substations on 50-Ton Steel Flats	2
Caboose Cars	3
Tool Cars	4
Steam Pile-Driver on 50-Ton Steel Flat	1
Pile-Driver Tender (oil and water tanks on 40-ton flat cars	1
Steam Roller	1
Bonding Cars	2
Lidgerwood Rapid Unloader (on 50-Ton Steel Flat)	1
Western Spreader Car	1
Total	65
FREIGHT CARS.	
Box Cars......80,000 pounds capacity	125
Flat Cars......80,000 pounds capacity	1
Flat Cars......30,000 pounds capacity, 1 P.E. flat at Riverside....	8
Flat Cars......60,000 pounds capacity	1
Flat Cars......30,000 pounds capacity	33
Flat Cars.....100,000 pounds capacity, steel	7
Dump Cars....30,000 pounds capacity	3
Dump Cars....60,000 pounds capacity	200
Dump Cars....80,000 pounds capacity	10
Dump Cars...100,000 pounds capacity, steel	49
Gondola Cars..80,000 pounds capacity	57
Beet Cars.....80,000 pounds capacity	50
Oil Cars........6,530 gallons capacity	4
Oil Cars........6,500 gallons capacity	15
Total	563
Total all cars	1,061

There is a large amount of local freight and express business, including milk shipments, which must be rapidly and readily handled. A special type of express car is used for this purpose. These cars are quite similar to the interurban class except that the car body is fitted for express and, in some cases mail service. These cars do light switching and are capable of hauling several loaded freight cars. In the accompanying view one of these cars is shown unloading at the Los Angeles freight shed.

There are four electric locomotives, one of them being of steel construction throughout, with a total weight of 102,800 lb.

Most of the freight and heavy switching work is

Typical Pacific Electric Interurban Car.

done with work motors. These are flat cars under which have been placed four-motor-equipment trucks and automatic air brakes. The heaviest of the work motors weigh 70,000 lb. The gear ratio is, in most cases, 21 to 61.

There are four tower cars, all with two-motor equipment and two wrecker cars with the same equipment as the work motors.

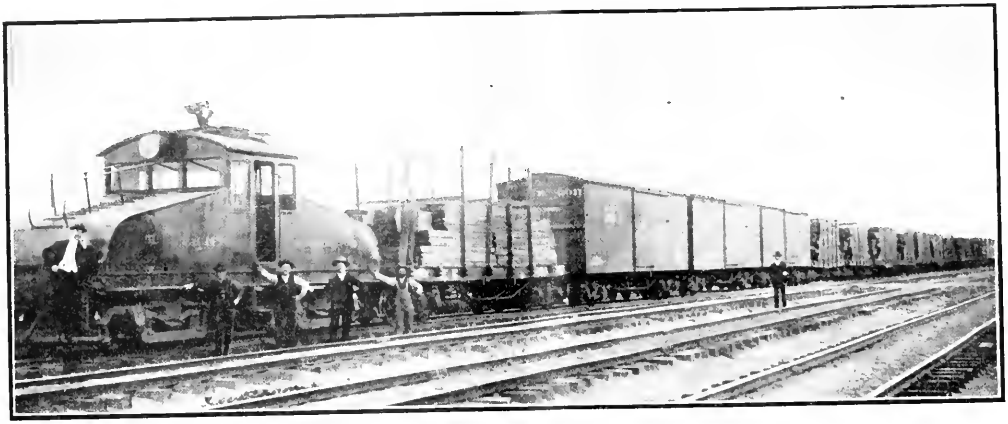
The equipment of the newer interurban passenger cars is as follows:

Control: Multiple Unit.
Motors: 4 Westinghouse No. 112.
Trucks: 6 ft. 4 in. Class "A."
Gear Ratio: 28-61
Axle: 5 in. by 9 in.
Gauge: Standard
Brakes: Westinghouse Automatic No. 5½.
Seating Capacity: 56.
Length: 50 ft. 10⅛ in.
Weight: 69,600 lb.
Maximum Speed: 55 miles per hour.

Operation and Traffic.

The system is divided and operated in three divisions, all under the supervision of a general superintendent, Mr. Thomas McCaffery. The Southern division includes the Whittier, Newport, Santa Ana and San Pedro lines and connections and enters Los

Typical Pacific Electric Express Car.



Regular Freight Train and Steel Locomotive.

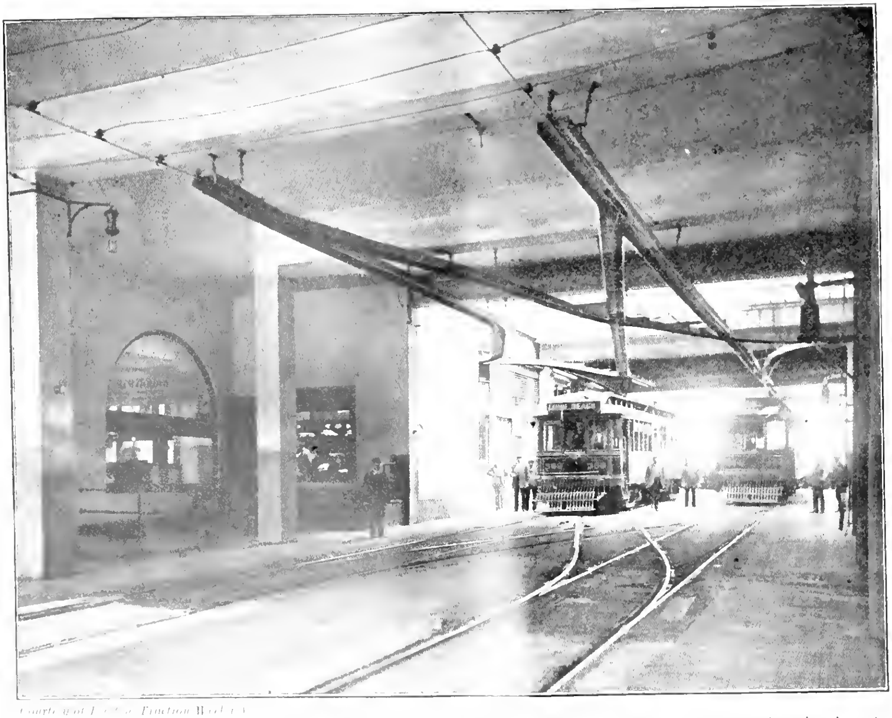
Angeles over the four-track trunk line between Watts and that city. The superintendent of this division is Mr. F. Van Vranken.

The Northern division begins at Los Angeles, includes the four-track trunk line to Oneonta Junction and the various feeders, the Glendora, Covina, San Gabriel, Pasadena Short Line, Pasadena Oak Knoll and Pasadena Old Line and the Sierra Madre line. This division is under the supervision of Mr. J. B. Rowary.

The third is known as the Los Angeles City division and includes all of the city lines, the Gardena line (narrow gauge) to San Pedro and the Glendale line. The superintendent is Mr. J. C. McPherson. The Pasadena local lines and Mt. Lowe Railway are operated by Mr. A. B. Wells, superintendent at Pasadena.

Each division has its own corps of dispatchers. There are eight in all; three each for the Northern and Southern divisions who work eight-hour shifts; and two on the City division, working nine-hour shifts. The dispatchers' offices are on the second floor over the train shed in the main depot at Los Angeles.

Trains are all handled on schedules which are so



Courtesy of [illegible] Traction Weekly.

Interior of Train Shed, Showing Arrangement for Automatic Reversing the Trolley, Los Angeles Depot.

arranged that a train has from five to seven minutes' leeway in a round trip from the main depot to terminal and return. Should a train be delayed for any reason and not arrive before its next leaving time, a new train is made up to run on the schedule and maintained until such time that the regular can start again on time. A number of cars are always in readiness for this emergency, being held on the elevated viaduct track at the rear of the train shed. Special trains are made up on advice of the passenger department, giving the number of people and are run as extras.

Train dispatching is done by telephone, Western Electric Company's phones being used exclusively The conductor reports the arrival and departure at terminals and the number of cars in his train. In case of delay, communication is maintained with the dispatcher from the stations or telephone boxes along the line.

On single-track sections, standard orders are used and before passing from double to single track the conductor gets from the dispatcher, orders or a clearance. The dispatcher is also notified when passing from single to double track.

Owing to the great number of lines and frequent service the system of dispatching must work accurately and with the least possible delay. The train upon arriving at the main depot must await its turn, receiving a semaphore signal at the proper moment. The train passes through the train shed, taken to the rear and awaits its turn, then it is immediately shunted to the outgoing track and takes its position to receive its passengers.

In switching, an ingenious device is used to turn the trolley. This consists of a series of inverted troughs arranged like a Y switch. These troughs are lined with sheet copper which is connected to the trolley wire: the wheel therefore receives current from any point on which it may bear in the trough. When the motion of the car is reversed, the Y trough forces the trolley wheel to the end of the Y until it is at right angles to the car and the further movement of the car draws it back through the other branch of the Y, finally restoring it to the trolley wire, but in the opposite position.

Trains are allowed from three to five minutes to get in and out of the depot. During the average 24 hour day, there are 1250 arrivals and departures of trains (not cars). This does not include local and city cars or express or freight cars, or special cars.

Trains are operated with one, two and three-motor cars, depending on the time of day and general traffic. Specials often consist of four or five cars, two or more of the cars being trailers or non-motor cars.

The cars are so constructed that once a passenger is seated, he cannot change to another car, unless he would wish to pay another fare, which is an invincible argument to make him keep his seat.

Every two-car train has a conductor for each car, the rear conductor acting as rear flagman. Each conductor collects the fares of his car only. With three cars, there are often but two conductors, the forward taking care of the two first cars, while the other handles the rear car and acts as flagman. In starting a train, the conductor on the forward car gives a bell

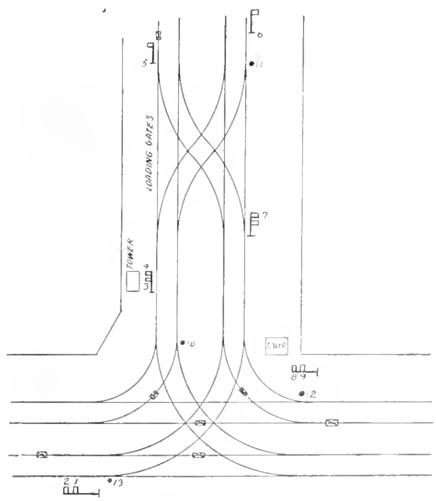
(Courtesy of Electric Traction Weekly.)
Entrance to Aviation Camp, Dominguez.

signal only after getting electric bell signals from all other conductors.

Conductors and motormen are paid at the same rate, 25 cents per hour during the first year of employment. After the first year the pay is increased 1 cent per hour each year until they have served five years, after which the rate remains the same. Conductors of freight trains are, however, paid 30 cents per hour after having been in service six months.

New men are first broken in on all lines; they then are required to pass an examination on rules by each division superintendent, and on equipment by a mechanical instructor. If these examinations are satisfactorily passed, the men are then placed on the extra list, eventually finding regular places as older men drop out, or as the operating requirements increase.

The passenger traffic is now so heavy that there is practically a steady stream of trains entering and



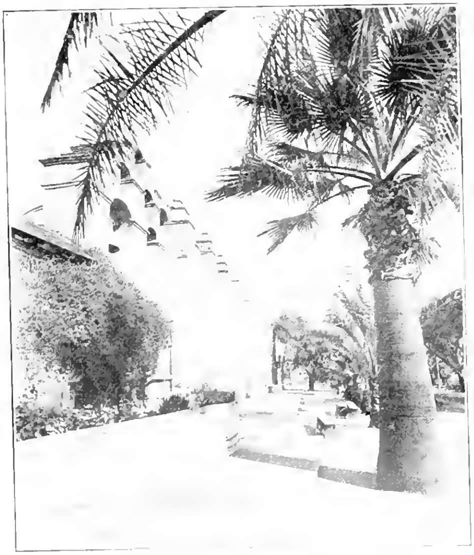
(Courtesy of Electric Traction Weekly.)
Plan of Tracks and Signals, Los Angeles Depot.

Freight Yards at Los Angeles.

leaving the main Los Angeles depot. The trains are either through trains, stopping nowhere on the trunk lines but at all the principal points on their respective sections, or "fliers," which make no stops until the terminal is reached, or locals stopping at points on the trunk lines. These latter trains (single cars, as a rule) do not, owing to the congestion in the main depot, enter or leave that station, but leave from an outside point nearby.

On the trunk lines, the two outer tracks are used for local and freight traffic, while the inner tracks are reserved for the through and express traffic.

While it is difficult to secure the total number of passengers traveling on an average day, some idea may be gained from the fact that, between Los Angeles and Pasadena alone, there is a through traffic of 23,000 persons in an average day. Between the hours of



San Gabriel Mission.

4:30 p.m. and 6:30 p.m. on the through trunk of the Northern division, trains are operated with one minute headway, while on the Southern division the headway is five minutes.

To give some idea of the amount of travel between Los Angeles and the beaches, 24 to 40 miles distant, there is a 20-minute, three-car train service maintained between the hours of 8 a.m. and 8 p.m. to Long Beach alone and on Sundays this service is maintained at 10-minute intervals. Every third train on the Long Beach line is a "flier," leaving Los Angeles on the even hour and occupies from five to seven minutes less time than the regular trains in making the run.

The company handles a diversified freight business. Switching and hauling gravel and crushed rock is done with freight motors. There is always much of this work as there is being hauled an average of 40 cars a day for the Pacific Electric's use in grading. Municipal requirements average 30 cars more. About 30 cars of sugar beets are delivered to the beet sugar factory near Santa Ana per day and as many more are delivered to the steam railroads for transportation elsewhere. Local freight and the transportation of milk and vegetables is handled by the standard express cars. These cars also do light switching and are capable of hauling several loaded freight cars on fast schedule.

In the main depot at Los Angeles, the passenger waiting rooms are adjacent to the outgoing track. The system of handling the many passengers without confusion is at once simple and effective. There are 10 doorways opening from the waiting room to the station platform and in front of each is a brass railing so arranged that the passengers in passing out to a train must do so in single file. The gateman stands in a space provided within this railing to examine all tickets. Over each of the doorways is an electric sign arrangement on which is etched the name of several of the principal towns of a particular line. When a train is in position to take passengers the names of the towns reached by the train appear upon the ringing of a gong, being made visible by a white board which falls in place behind the letters and which is electrically actuated from a switchboard operated by the towerman in the train shed. The gateman at the same time calls out the train and the names of the stations.

The Passenger Department.

The passenger department, under the supervision of the general passenger agent, Mr. D. A. Munger, is largely responsible for the half million and more tourists and numerous conventions whose annual patronage has made profitable much of this system's wonderful development. Attractive literature, a model of its kind, has been so widely disseminated throughout the world by this department, that there is no tourist and no convention unfamiliar with the hotel accommodations and sight-seeing inducements of Los Angeles and vicinity.

Substation Equipment and Power Supply.

Like every other part of this system, the idea of standardizing has been followed in the arrangement and operation of substations and the supply of power, in so far as it has been possible, considering the advances and changes that have been caused by the rapid increase in the demand for power and the refinement of the art.

There are 22 substations in active operation, 2 portable substations which may be shunted and placed in service on short notice at any point on the network where it may be necessary to centralize a large amount of power; and 1 central station in active operation in Los Angeles. The substations and electrical operation are under the supervision of the electrical engineer, Mr. S. H. Anderson, one of the department heads who has been with the system since its start.

Of the substations, there are two general types, and descriptions of an example of each type will suffice to convey a comprehensive idea of the entire equipment.

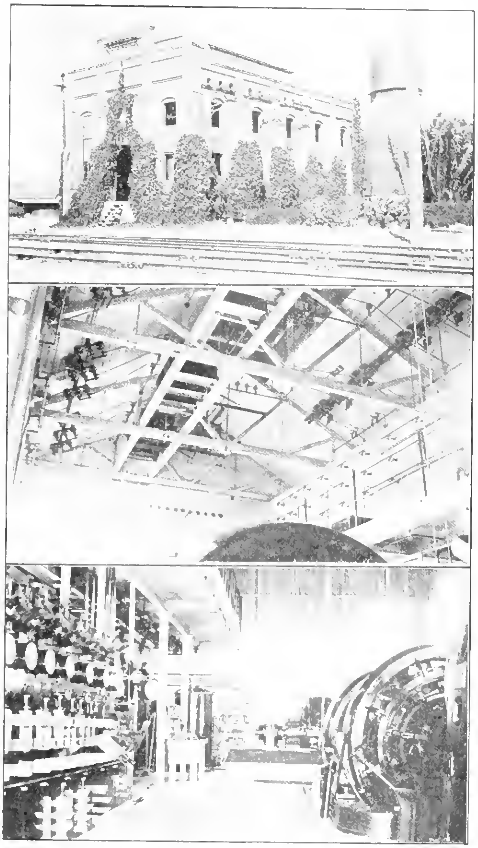
The older type, which in general appearance was well standardized, applies to 20 substations; the buildings are of brick with buttressed walls and plain gable roof, the latter having patented roofing covering, supported on timber purlins and trusses.

The windows, of size and number to give ample light, are distributed between the buttresses and above them immediately under the eaves are the openings for the high tension lines which consist of 12-in. sewer tile. The 600-volt outgoing feeders, as a rule, are brought through the front wall, or the side nearest the track and are carried directly to the trolley and the line feeders. In many cases a water tank mounted on a timber structure supplies a constant head for cooling transformers and in some instances where water is difficult to get, i.e., where it must be pumped, a cooling tower is mounted on the roof of the building. The interiors are calcimined throughout in a light color or white, giving a pleasing and airy appearance, while the grounds surrounding the buildings are laid out in lawns and shrubbery and in many cases a profusion of climbing vines and semi-tropical foliage turns the ordinarily plain industrial building into a beauty spot.

The arrangement of apparatus is invariably simple and efficient. Motor generators are used throughout and occupy a large part of the main floor. The switchboards are similar in equipment and follow standard 600-volt practice, although in arrangement were designed by the engineers of this company.

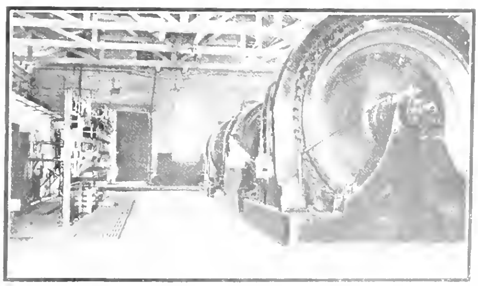
The transformers are all of 475-kw. capacity, having a voltage ratio of 15,000 to 2350-2200. In the older stations these are in sets of two, connected on the Scott system, receiving three-phase current on the primary side and delivering two-phase currents from the secondary. The newer units are, however, three-phase throughout and delta connected on both sides. The transformers are placed to the rear or side, but on the main floor, without the use of cells or compartments. The high tension switches are of the Kelman type and are placed on a gallery or shelf convenient to the incoming lines.

The substation at Watts, which is typical of the general style just described, is equipped with three motor generator sets. As this substation is one of the oldest on the system the equipment is not uniform, due to the additions which have been necessary from time to time, as the requirements on the plant have increased. The first set is a two-bearing Westinghouse and consists of a 600-kw., 600/550-volt, direct current generator, driven by an 850-h.p., 2200-volt, two-phase type "C" induction motor and operating at 415 r.p.m. The second set is made up of two Stanley self-contained machines; the generator is of 600 kw. capacity and is driven through a flexible leather link coupling by a synchronous motor. The motor is rated at 640 kw. and operates at 2200 volts, three-phase, with a speed of 375 r.p.m. Mounted on the motor shaft is a 5-kw., 120-volt, direct current generator to supply the necessary exciting current for the motor.



Substation at Watts. High Tension Oil and Disconnecting Switches. Motor-Generators, Switchboard and Transformers

The third set is of a recent Westinghouse two bearing type; the generator has the same specifications



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as the first set; it is, however, more compact and efficient and operates at the higher speed of 580 r.p.m. and the field mounting includes interpoles. A cast iron shield surrounding the field and armature on one side serves to give the air currents set up by the motion of the armature a uniform direction, thus acting as a blower which maintains a safe operating temperature in all parts of the windings.

The induction motor driving this set is 900 h.p. and operates with three-phase current at 2200 volts.

There are three sets of transformers, one for each motor-generator; the first consisting of two 475 k.v.a., 15,000/2200 volt, Scott connected three to two-phase water-cooled Westinghouse transformers. The second set are three 220-k.v.a., water-cooled Stanley transformers delta connected on both primary and secondary, having the same voltage rating as the first. The third set is similar in size and make to the first, except that there are three transformers, supplying three-phase current at 2350 volts, being delta connected on both sides.

There are two 15,000-volt bus-lines which pass over the transformers and each set is connected to these lines through four-way disconnecting switches.

Mounted on a concrete and steel gallery are three sets of Kelman 15,000-volt oil circuit breakers, manually operated.

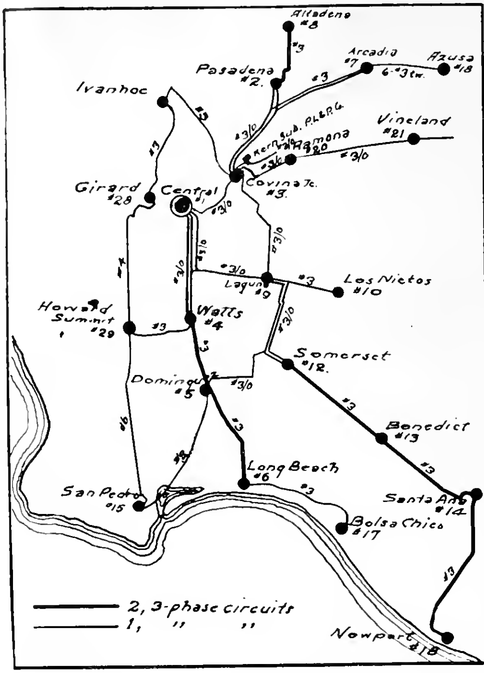
The switchboard, supplied by the General Electric Company, consists of 10 panels of black slate. Four of these are feeder panels and on them are mounted an ammeter, circuit-breaker and switch. The next three panels control, each, one of the direct current generators and are similarly mounted, while the remaining three panels control the motors and are equipped with oil-switches, voltmeter, ammeter and recording wattmeter.

This substation receives high-tension current, both from the central station at Los Angeles and from the steam plant at Redondo Beach. It therefore acts as a sectionalizing point and the circuits, three from each of the sources of supply, enter the building on opposite sides. After passing through double throw disconnecting switches are connected through three sets of Kelman 15,000-volt oil circuit-breakers. These are mounted between the roof trusses.

Of the more modern type of substations, there is one completed and in operation; this is known as No. 3 and is located at Covina Junction, on the trunk line of the Northern division and three miles from the central station in Los Angeles. The building is of reinforced concrete throughout and is therefore fireproof. It was built to take the place of an old and much smaller station near Eastlake Park and has the largest output of any of the substations. This requirement is necessitated by the multiplicity of lines and the enormous traffic which is centralized in the zone supplied from this substation.

Power is supplied from the central station and through it from the Redondo plant, also from the Kern River substation of the Pacific Light & Power Company. Aside from the lines brought to the substation from these sources, other lines radiate from it to other substations. It therefore acts as a sectionalizing station in the 15,000-volt distribution network.

Leading in and out of the building, there will



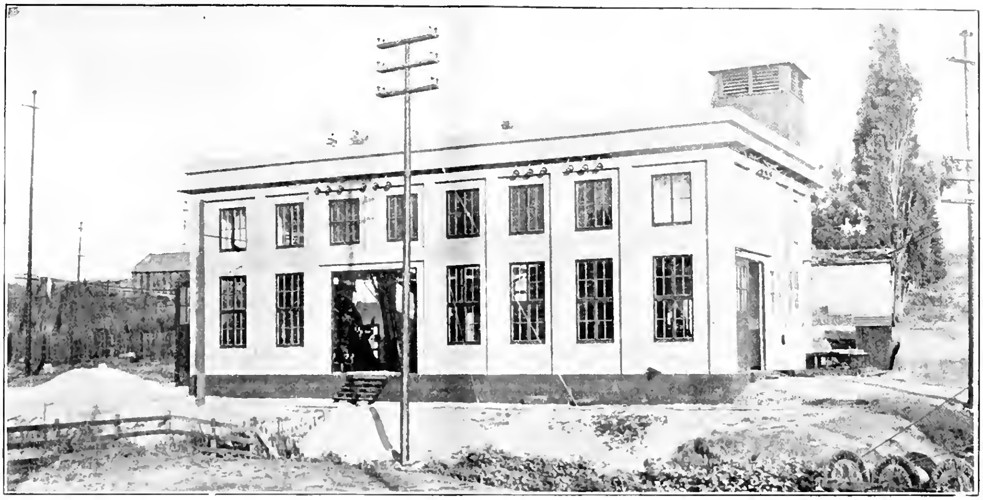
Map Showing Lines of the 15,000 Volt Power Distribution and the Position of Substations.

eventually be eleven 15,000-volt circuits, although nine are at present installed. These circuits pass through the walls in square openings on the front and the two ends. A cornice immediately above these openings prevents rain from driving through them.

Upon entering the building, the lines are carried to double throw disconnecting switches, and from each of these switches connection is made to two sets of Kelman 15,000-volt oil circuit-breakers.

A concrete gallery across the rear and the two ends of the building serve to support the Kelman pantagraph circuit-breakers or switches. As there are a great number of these,—28 sets when all are installed,—a unique arrangement has been adopted in order to confine them in the space alloted and at the same time make them accessible and give ample protection. The gallery is divided longitudinally by two parallel concrete walls about 2 ft. apart. On the outer side of each of these walls are arranged the Kelman switches, each set separated from its neighbor by a short transverse concrete wall, but open on the front side. Suspended horizontally from the longitudinal walls and directly over the lines of switches are two bus circuits; these are in three sections, but may be joined by disconnecting switches. The 15,000-volt lines after entering the building, pass down through the space between the parallel walls to double throw disconnecting switches suspended from the underside of the gallery floor, and thence, two circuits are carried up through the gallery floor, one to a rear set and one to a front set of Kelman switches. Current passes through these switches to the bus-circuits.

There are three sets of transformers and each is



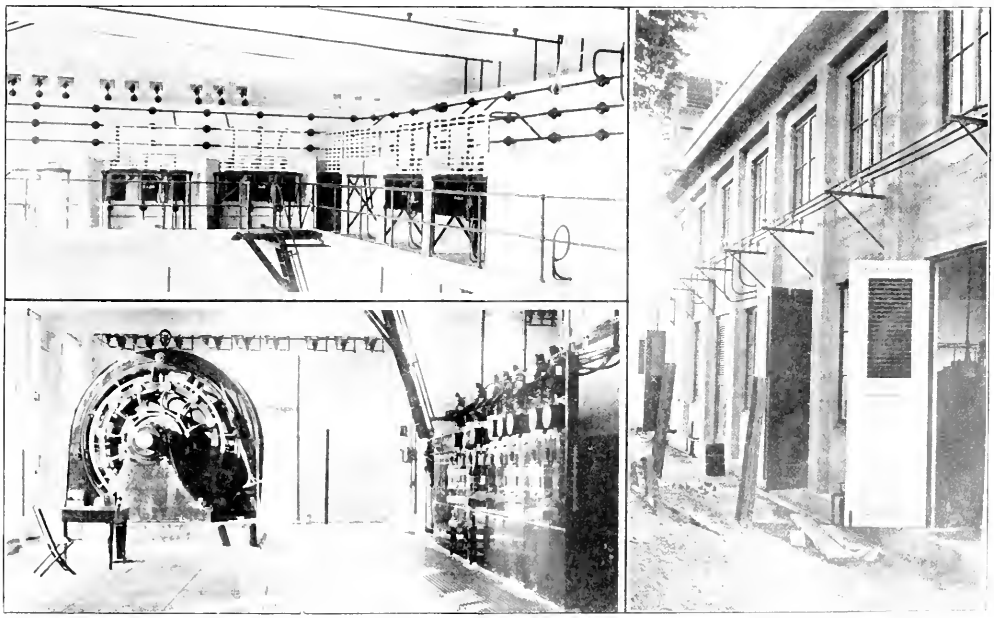
Substation No. 3 at Covina Junction.

supplied through two sets of oil switches, one connected to each bus-circuit and similar in type and setting to the line switches. They, however, receive their current from the bus-circuits and it then passes down through the floor to a double pole disconnecting switch and thence to the transformers.

The Kelman switches are operated entirely by compressed air at a pressure of 60 lb. per sq. in., the controlling valves being placed on the rear of the switchboard on the panels controlling the high-tension circuits. Hand operation is, of course, always possible by a lever mounted on the switch mechanism.

The three sets of transformers are placed, each in a fireproof compartment, at the rear of the building; two of the compartments are at either end and the third in the center. Large doors in the rear wall serve as an opening to these compartments, but there is no opening or passage between the compartments and the main interior.

There will be in each compartment three 475-k.v.a. Westinghouse transformers (the center compartment is not yet equipped), the voltage ratio being 15,000 to 2350, the standard adopted by this company. The transformers are delta connected on both sides.



Substation No. 3: 1—High Tension Switch Gallery; 2—Rear of Building Showing Transformer Compartments; 3—Motor-Generator and Switchboard.

The secondary circuits from the transformers are carried under the floor through Orangeburg fibre conduit to the motor-generators.

There will be three motor-generator sets, but two being in operation at present. These machines are highly efficient and modern, furnished by the Allis-Chalmers Company, and are of the two-bearing type.

The generator is rated at 1000 kw., delivering direct current at 550/600 volts, and is driven at 294 r.p.m. by a 2200-volt, three-phase induction motor, rated at 1500 h.p.

The switchboard follows the standard practice of this company, there being seven feeder panels, three generator and motor panels and three panels devoted to the high-tension switch system.

Mounted on the roof of the building is a cooling tower. Water is pumped through a Deming three-crank plunger pump, driven by a 1-h.p. General Electric induction motor through the transformer circulating system and thence to the cooling tower.

Compressed air to operate the Kelman switches and for cleaning purposes is supplied by two Westinghouse 3.85-h.p., d.c., air-compressor sets. It is delivered into two vertical tanks, made from iron pipe. These are 15 in. diameter and 15 ft. long, and pressure is automatically maintained by an electric pump governor.

At Pasadena the substation occupies the building, once a steam generating plant for the local system. There are three motor-generators, two being two-bearing Westinghouse equipments, similar to those used in many of the other substations, while the third is an Allis-Chalmers equipment and is similar to the machines in the new substation No. 3, just described.

Two sets of two each, Westinghouse 475-kw. Scott connected transformers supply two-phase currents for the two Westinghouse motor-generator sets and one set of three similar transformers supply three-phase current to the larger machines.

Portable Substation.

There are two portable substations, which, while relatively small in output, are by no means so in importance. The design of these substations has been carefully developed and the results have been most gratifying.

The car on which the station is mounted is a standard 40-ft. flat; the body is similar to the express car bodies, except that the ends are readily removed by the unfastening of four bolts. By this means the apparatus may be moved in or out.

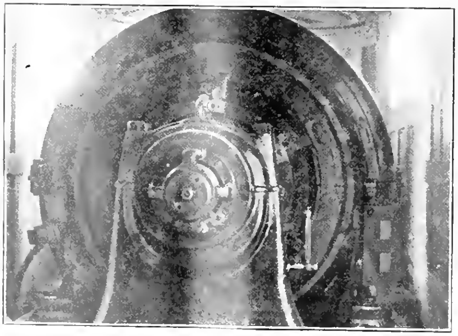
High-tension wires are introduced through a cupola on the roof, current first passing through a set of disconnecting switches. The car may be hauled on short notice to any point and shunted to a siding, connection being made to the 15,000-volt lines which are invariably mounted on the top of the trolley pole system on all routes.

To prevent vibration of the car from the machinery within, four standard 15-ton track jacks are placed under the car frame when the station is in use. One of these may be seen in the picture of this car.

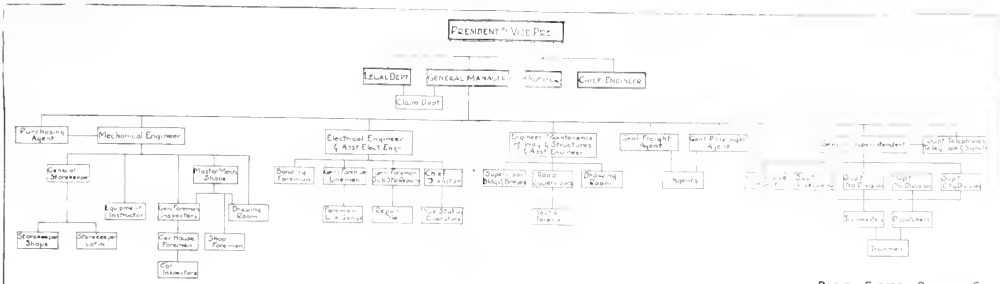
Directly under the incoming lines, within the car body, are three Westinghouse 475-kw., water-cooled transformers similar to those in the substations Occupying the opposite end is one of the later 600-kw., two-bearing, ventilated Westinghouse motor-generator

EQUIPMENT OF SUB-STATIONS.

Station.	No.	A.C. Motor Horsepower.	Generator KW.	R.P.M.
Central	1	1500	1000	300
"		850	600	375
Pasadena	2	1500	1000	300
"		850	600	415
"		850	600	415
Covina Junction	3	1500	1000	294
"		1500	1000	294
Watts	4	900	600	580
"		850	600	375
"		850	600	415
Dominguez	5	850	600	415
"		850	600	375
Long Beach	6	850	600	415
"		850	600	415
Arcadia	7	550	400	375
"		850	600	415
Altadena	8	285	200	500
"		285	200	500
"		550	400	415
Laguna	9	550	400	375
Los Nietos	10	900	600	580
Somerset	12	900	600	415
Benedict	13	550	400	415
Santa Ana	14	900	600	500
San Pedro	15	900	600	500
"		550	400	415
Bolsa	17	850	600	415
Newport	18	900	600	415
Azusa	19	550	400	415
Ramona	20	900	600	580
Vineland	21	550	400	415
Ivanhoe	27	550	400	415
"		900	600	580
Girard Street	28	850	600	415
"		850	600	415
"		600	400	375
Howard Summit	29	300	200	500
"		300	200	500
Portable A		900	600	580
" B		900	600	580
Pomona		175	100	
"			40	
"			40	
Total		32,395	22,380	


Portable Substation. (1) Exterior. (2) 600 Kw. Generator. (3) Switchboard and Transformers.



PACIFIC ELECTRIC RAILWAY CO.
ORGANIZATION DIAGRAM 1910

sets already described. On one end of the shaft is a device known as a ball oscillator, for the purpose of giving the shaft a periodical end motion. This consists of a steel ball about ⅝ in. diameter bearing on the shaft-end in a circular track and on a stationary cap also in a corresponding circular track which, however, has a gradual hump. The ball covers the track once for every two revolutions of the shaft and in passing over the hump imparts the lengthwise motion to the shaft. A coiled spring at the other end maintains a pressure on the oscillator.

A two-panel switchboard in the center of the car controls the motor-generator, while a 1½-h.p. General Electric motor and centrifugal pump delivers the circulating water from any convenient source to cool the transformers.

As an illustration of the possibilities of these portables; they have both been sent to the race track at Arcadia on Saturdays or holidays, where they were operated in parallel with the substation at that point, and where they would handle 85 to 100 loaded passenger cars within a space of 35 minutes.

The view shows the portable substation connected in the shop yards to augment the current supply within the city of Los Angeles.

Source of Power.

There are a number of sources whence power is delivered in large quantities in Los Angeles and the surrounding country; there are large steam plants and also water-power plants in the mountains, transmitting power, in some cases, 100 miles or more. In this article it is not intended that any of them shall be described

The Pacific Light & Power Company, a corporation entirely separate from the property described, own a number of the steam and hydraulic power-plants, and it is this company that delivers at several points, all of the electric energy required by the railway system. It is true that the railroad company owns the central steam generating plant in the city of Los Angeles, but even that plant is operated entirely by the power company and only at such time as the supply from other sources is inadequate.

The greater portion of the power is derived from the modern steam generating station at Redondo Beach. Electric current is generated at a potential of 15,000 volts, three-phase and with an alternating frequency of 50 cycles per second. This frequency is peculiar to this section of the country and was adopted, probably, in consequence of European practice, at a time when the long distance transmission of electric energy was in its infancy.

There are a number of transmission lines radiating from the Redondo station to supply the substations at different points on the system. During the Fall period of low water the hydraulic plants supply little power, but current from these plants is delivered to the Kern River substation near Eastlake Park and from that point delivered to the railway substation No. 3 at Covina Junction. This, it has been explained, is a sectionalizing point and from it the high-tension current is carried to other substations.

PROPOSED CALIFORNIA PUBLIC SERVICE COMMISSION.

At a meeting called by Meyer Lissner, chaiman of the Republican State Central Committee to listen to reports of legislation proposed for the next session of the California Legislature, Percy V. Long read a report from the committee that had been appointed to prepare a plan for a State public service commission, saying that the measure which it would submit would provide for a commission with the following powers: To issue permits to persons and corporations to engage in public service business; to compel complete publicity in the affairs of corporations and individuals engaged in public service; to control stock and bond issues of public service corporations; to authorize and require capital expenditures; to regulate and prescribe the terms on which franchises may be acquired, to control sales and leases of the property of public service corporations; to compel adequate service and the use of safety devices and to control construction in public service work; to determine the value of property devoted to public service; to assist municipalities in acquiring the property of public service corporations by acting as arbitrator or appraiser when requested so to do; to advise municipalities as to the reasonableness of rates to be fixed for public service.

The committee has not decided whether to give such a commission broad general powers, re-enforced by necessary amendments to the codes, or to follow the New York and Wisconsin plan, and provide in the act creating the commission all of the details necessary for the carrying on of this work.

RECONSTRUCTION OF SEMI-OBSOLETE ELECTRICAL MACHINERY.

BY H. ALTMAYER.

Foremost among the points brought to the attention of electrical engineers, both from an operating and commercial standpoint, are the questions of what to do with out-of-date electrical apparatus and what expense is warranted in adapting it to modern requirements. Single-phase alternators above 25 kw. capacity, especially those which were built for such frequencies as 125 and 133 cycles, are so nearly obsolete that it is usually best to consign them to the scrap heat. For small alternators, ranging in capacity from 5 to 15 kw., there is some demand for use on the low

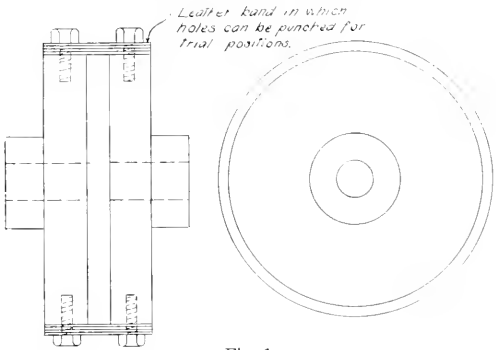


Fig. 1.

voltage lighting systems which now prevail and in conjunction with wireless telegraphy.

For tungsten lighting systems at places where there is no alternating current supply, 133 cycle apparatus can be used by running the alternator at about

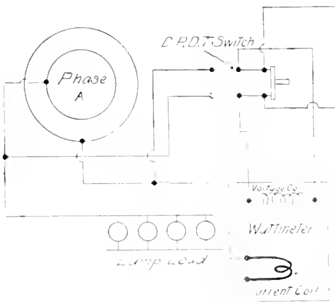


Fig. 2

45 per cent of its rated speed, thereby giving the same ratio of voltage and from 30 to 50 per cent of the rated output, with fair regulation and not excessive friction, iron or copper losses. In San Francisco small alternators are frequently used for operating low voltage electric signs in conjunction with low voltage transformers by companies supplying only direct current.

It is also possible to mechanically connect two 60 cycle single-phase alternators, by placing their armatures in quadrature so as to obtain two-phase current, provided they have the same number of poles. The exact mechanical position of the two windings can be best determined by means of some mechanical coupling which can be shifted so as to place the armature windings in quadrature, one method for doing this being shown in Fig. 1.

The position of the two armatures can be determined mechanically within 20 degrees from the slots and coil ends, a closer trial adjustment being made by connecting the machines as in Fig. 2, which shows a wattmeter, either recording or indicating, with its current coil connected in series with a suitable non-inductive load, such as incandescent lamps, and the pressure coil connected first to phase A and then to phase B. The

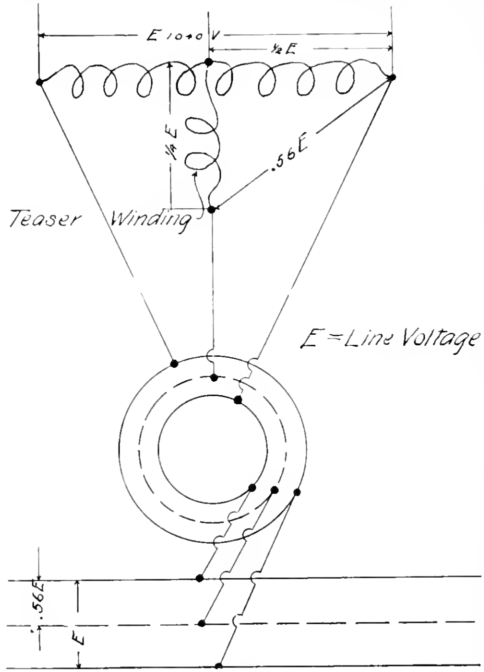


Fig. 3.

voltages of both machines should be kept the same during this test. When the flanges are adjusted exactly in quadrature the meter will give no power reading, as the load will be equal to zero power factor when the current coil is connected with one machine and the voltage coil with the other.

It is also possible after a first trial to compare the respective wattages of the two connections and to determine the error of the angle, which can be laid out on paper so that the subsequent tests will determine the exact angular position. A check on the phase conditions may be obtained by connecting the machines as two-phase, three-wire, when the voltage across the two outside wires will be 1.414 times that of one machine.

Monocyclic generators in vogue some years ago can be rewound to make satisfactory three-phase alternators. These machines were built in sizes up to 800 kw., usually being of the revolving armature type with compensated field windings. The writer recently had occasion to rewind such a 250 kw. machine with a volt-

age of 1040 and speed of 450 r.p.m. This generator was constructed with two sizes of slots in the armature, there being 16 coils in the main winding and 8 coils in the teazer winding. Fig. 3 shows the diagram of connections.

Although there were two sizes of slots it was found that they could both be utilized to hold the armature winding for a 250 kw. 2400 volt, three-phase generator by using square magnet wire and allowing 500 circular mils per ampere. There was enough room in

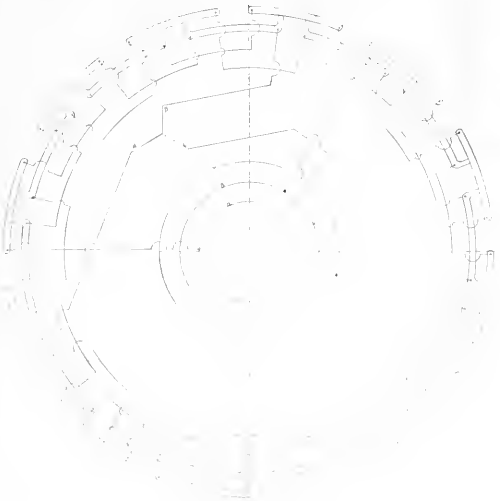


Fig. 4.

the small slots to allow ample insulation for this new winding, while the extra space in the larger slots was filled with extra slot insulation and heavier wooden strips. The armature contained 48 slots, 16 small and 32 large, the coils being originally spanned in 1 and 3 for the main winding and 1 and 4 for the teaser winding. Fig. 4 shows the new winding diagram.

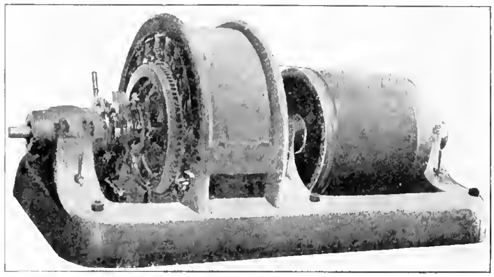
The rectifying commutator was disconnected and the compensating field coils were connected eight in series, two sets in multiple, and placed in series with the regular shunt field winding so as to strengthen the field. The no-load test on this machine was as follows:

Field Current.	A.C. Voltage.	Power Required
8.2 amperes	1440	8 h.p.
16 "	2400	10 h.p.
19.6 "	3200	16 h.p.

The field voltage on the last test was 108 volts. The impedance or short circuit test as conducted with full load current showed a field excitation of 7 amperes at 40 volts with a mechanical input of 7 h.p. A similar test of the single-phase alternator before stripping showed a field current of 12.5 amperes for full load current and mechanical input of 15 h.p. and field current of 21.4 amperes at a mechanical input of 21 h.p.

Comparisons of the monocyclic and the three-phase machine shows better regulation and much lower iron losses for the latter, both these tests being exclusive of the power taken by the exciter. The friction and windage losses of this machine was approximately 4.5 h.p., although the revolving element with pulley and shaft weighed about six tons. The weight of the entire machine was 16 tons.

This machine is now being operated in parallel with revolving field alternator supplying current to a number of induction motors, the larger being 125 h.p.



Monocyclic Generator Before Rewinding.

squirrel-cage types. The entire reconstruction was completed within thirty days after receipt of the machine, being done in the shops of the Farnsworth Electrical Works of San Francisco.

POWER RATES FOR ELECTRIC VEHICLES.

The Public Service Commission of Wisconsin recently decided that the Milwaukee Electric Railway & Light Company was justified in making a minimum rate of $5.00 per month for charging an electric vehicle. This was based on a rectifier capacity of 6 kw. The Commission called attention to the fact that such service is usually furnished at times of light demand and has been accorded a special rate by many companies. Before this complaint was filed the company had already established certain optional "off-peak" and "ten to seven" schedules.

Distinctive colors for high tension lines is suggested in France as a needed protection for aviators.

Corn growing in Alabama as undertaken by a chain of boys' corn clubs is the latest venture in the new South which finds its counterpart in the cotton growing now being introduced in California.

The largest oil tanks of reinforced concrete are the two reservoirs of the Union Oil Company at San Luis Obispo, California. Each is 601 ft. inside diameter and 20 ft. 4½ in. above grade and will hold more than 1,000,000 barrels of oil. Oil is pumped through the 200-mile 8-inch pipe line of the Producers' Transportation Company from the Bakersfield, Coalinga, Sunset, Maricopa, McKittrick and Midway fields.

No monopoly of the atmosphere is recognized by the court which recently decided that the Chicago, Lake Shore and South Bend Railway Company's 6600 voltage line does not constitute a nuisance even though inductive effect interfered with the working of adjacent telegraph lines. The court stated that if this effect interfered with the operation of the telegraph lines, the telegraph companies should provide such mechanical or electrical devices as would protect their lines.

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POWER AND GAS

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E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.
DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Interurban Electric Railway

The great barrier that long separated town and country has been removed by the interurban electric railway, which brings health to the townsman, happiness to the countryman and contentment to both. To the farmer's boy the city has ever been the more alluring because he could not get to it, while to the city clerk it has been the more irksome because he could not get away from it. The interurban makes possible a country home for the city worker and gives city advantages to the ranchman. Each form of life has certain privileges which are now accessible to the other. The country develops the physical side of man by its pure air and food, while the city develops his mental side by its facilities for education and entertainment.

The electric interurban has also solved the economic problem of the costly short haul for the steam road and the tedious long haul of the wagon road. Electric traction is well adapted to frequent service at low rates, a service which is possible neither with the steam locomotive nor with the farmer's wagon. Before the advent of the telephone and electric car, the farmer was isolated not only from city enjoyments but also from the city markets. Oranges could be shipped a thousand miles almost as cheaply as ten. Prohibitive cost frequently forced the railroad to neglect the short haul, while the time consumed often deterred the farmer from a long wagon haul to market. Consequently many electric roads find a freight traffic which can be handled at times of slack passenger travel as profitable as a passenger traffic which is cheaper to handle because it moves itself.

The recentness and rapidity of this growth is indicated by the fact that but few dictionaries define the word "interurban," which was coined to distinguish this method of traction from the urban and suburban systems of which it is an outgrowth. Its first great difficulty, that of voltage drop over the long distances, was overcome by three-phase alternating current transmission and subsequent direct current distribution.

Though the interurban road has found its greatest field in the Middle West it will be but a few short years before the Pacific Coast is similarly gridironed. The story of the Pacific Electric Railway at Los Angeles, as detailed in this issue, shows how intimately it has been connected with the development of the surrounding territory. Though this system is now recognized as the peer of its kind, similar lines radiating from Spokane, Seattle, Portland, San Francisco and the interior towns of California are yet to tap a virgin country of even greater richness, thus promising extensions which will make it possible to travel from the Coeur d'Alene's of Idaho to the boundary line of California and Mexico.

PERSONALS.

S. N. Griffith, the Fresno electric railway builder, visited San Francisco this week.

C. P. Bockius is in charge of the power plant of the new Empress Theater on Market street, San Francisco.

R. D. Holabird, president of the Holabird-Reynolds Company, is visiting his branch electrical supply house at Seattle.

C. A. Bennett, representing manufacturers of railway car appliances, arrived at San Francisco last week from Los Angeles.

Arnold Pfau, chief hydraulic engineer of the Allis-Chalmers Company, is at the San Francisco district office of this company.

Dr. C. B. Laughlin, who has electric power interests in Northern California, arrived at San Francisco from Payne Creek last week.

C. H. Gaunt, general superintendent of the Pacific division of the Western Union Telegraph Company, is confined to his home by illness.

John Coffee Hays, general manager of the Mount Whitney Power Company, came up from Visalia to see the old year out at San Francisco.

F. B. Gleason, manager of the Pacific Coast branch of the Western Electric Company, has left San Francisco for a trip covering Portland, Seattle and Salt Lake City.

S. J. Lisberger, engineer of the electric distribution department of the Pacific Gas & Electric Company, made a trip through Northern California during the past week.

F. E. Shaw, who is interested in the Yosemite Power Company, a W. P. Hammon interest with an authorized capitalization of $10,000,000, is a San Francisco visitor.

J. V. Kunze, Atlantic manager of the Pelton Water Wheel Company, has returned to New York City after spending several weeks at the San Francisco plant of the corporation.

C. A. Coolidge, general manager of the Spokane, Portland & Seattle Railway Company, returned to his headquarters at Portland, Ore., during the past week, after spending New Year's at San Francisco.

A. R. Rhoades has arrived at the San Francisco office of the Western Union Telegraph Company from New York, for the purpose of introducing an improved system of accounting throughout the Pacific division.

P. M. Downing, head of the operation and maintenance department of the Pacific Gas & Electric Company, has returned to his San Francisco office after an inspection of the hydroelectric transmission lines.

The Farnsworth Electrical Works of San Francisco gave an enjoyable dinner to twenty-four of their friends and employees on the evening of January 1, 1911, at Jules Cafe. Informal speeches were made by all present, expressing a most commendable spirit of co-operation between employer and employee. The officers of the company present were H. Altmayer, president and assistant manager; H. T. Adams, secretary and manager; H. L. Rothchild, vice-president; A. Altmayer, and J. M. Jacobi.

A unique theater party was enjoyed by members of the "Engineers' Club" of San Francisco at the Empress Theater, on the night of December 20th, through the courtesy of Sidney Grauman of the management. Among those present were Messrs. George, Davis, Brewer, Herzog, John Carter, Jack Tranor, Phil Ennor, Herman Nothig, W. T. Bonney, William Jenkins, A. C. Arbuckle, Charles Elasser, and Joe Green. A lantern slide of a group of the members was thrown upon the screen at the show and Yeoman, the German comedian, made up a "local hit," upon each of the engineers in the party.

NEW CATALOGUES.

House Goods Bulletin No. 9550, from the Western Electric Company, lists in an attractive manner apparatus, appliances, tools and devices intended for everyday household use. The line carried by the Western Electric Company is complete in every branch of the electrical trade, though in this bulletin an attempt has been made to keep down to the actual "house goods" caliber.

The Westinghouse Department of Publicity have issued "Modern Merchandising Establishments Example No. 2" on the Higbee Company store in Cleveland—the first of the series being on the Marshall Field & Company store, Chicago. Although this series is published by the Nernst Lamp Company, still the advertising feature is shunned and a complete description of store arrangement and methods is given.

Dossert & Company have issued their Catalogue No. 5 on Dossert Solderless Connectors. It contains 62 pages 9x6 in., and gives complete information and dimensions of all types, sizes and parts of connectors. The stud connectors, the connector for grounding and short circuiting high tension lines, and the insulating covers for cable taps have not heretofore been shown. The book also contains useful information regarding the construction of cables, their diameters in mils and in inches and decimal equivalents, etc. It is completely indexed and code words are provided for convenience in telegraphing.

TRADE NOTES

The Pelton Water Wheel Company of San Francisco is making shipments under a contract with the Grangeville Electric Light & Power Company to Grangeville, Idaho. The plant will include a Pelton-Francis turbine of 550 h.p., direct-connected to a Westinghouse generator, operating under a head of 59 feet at 600 r.p.m. The wheel is of the double-runner cylindrical-case type. The plant carries a mixed power and lighting load for the town of Grangeville and the surrounding mining communities.

The Tracy Engineering Company of San Francisco has been appointed local sales agent for the Ridgway Dynamo & Engine Company, the well-known manufacturers of high-speed engines and of direct and alternating current apparatus, particularly of the Thomson-Ryan sparkless direct current generators and motors. The Ridgway Dynamo & Engine Company has recently brought out a new four-valve engine which has some features of special merit.

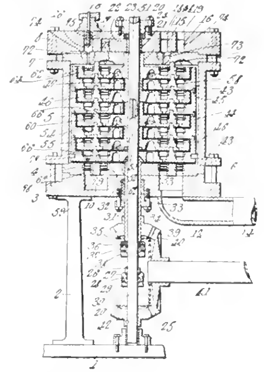
The Kellogg Switchboard & supply Company closed a number of deals during December, 1910, which indicates considerable development in the telephone field within the next few months. Contracts have been closed with the Exeter Home Telephone Company for a 200-line magneto switchboard; the Roseville Home Telephone Company, for a 100-line magneto switchboard, and the Moscow Telephone & Telegraph Company of Moscow, Idaho, for a complete two-section, six position central office equipment, arranged for four-party harmonic party line service. This installation will be complete with power plant, harmonic pole changes and subscribers' station equipment. All of these companies connect with the Long Distance system of the Pacific Telephone & Telegraph Company, and indicates an intention on the part of the various stockholders to furnish the public the most up-to-date telephone service obtainable.

THE FAR EASTERN REVIEW.

The November, 1910, number of the Far Eastern Review of Manilla, P. I., contains an illustrated account of the visit to China of honorary commercial commissioners representing the Associated Chambers of Commerce of the Pacific Coast who were the guests of the Associated Chinese Chambers of Commerce.

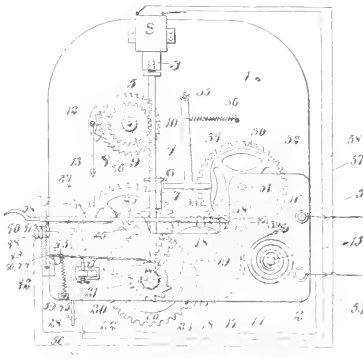
PATENTS

979,619. Turbine. Thomas J. Westerman, Olalla, Wash. In a device of the class described, a plurality of superposed rotors provided in their upper faces with concentric, inner and outer channels, the inner and outer channels of each rotor being alined with the inner and outer channels of the adjacent rotors and having communication therewith; racks removably mounted in the channels and



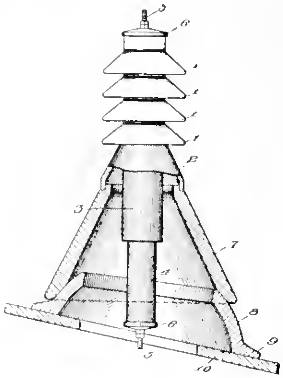
provided with blades inclined in one direction in the outer channels and in an opposite direction in the inner channels, to provide for a reversal of the rotors; each rotor being provided with an upstanding annular rib, positioned between the concentric channels of said rotor, and adapted to register in an annular groove in the superposed rotor, to prevent the passage of fluid under pressure from the inner to the outer channels transversely.

979,769. Electric Signaling Box. Arthur Kempston, San Francisco, Cal. In an electric signaling box, an electric circuit, a signaling mechanism, means to drive said mechanism, a slowly movable plunger adapted to hold the signaling mechanism in a position ready to send a signal at the first



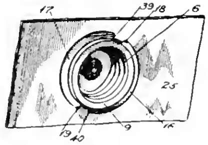
moment the line is clear of other signals, means to return the plunger to its initial position instantly if the line is operated during the period of initial movement of the plunger and before the signal has been started from that box, means to stop the mechanism, a solenoid for moving said plunger, and means to cut the solenoid out of circuit at the end of the set of signals.

979,840. Insulator-Base. Walter T. Goddard, Victor, N. Y., assignor to Locke Insulator Manufacturing Company, Victor, N. Y. The combination with the hollow lower base section having the upper exterior spherical surface and the upper



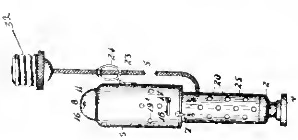
hollow base section having the lower portion fitting over and universally adjustable upon the lower section of an insulator embodying one or more petticoated insulating sections supported upon the upper edge of the upper base section and having the downwardly extending portion passing into the base.

979,927. Electric-Light Receptacle. Henry D. Brown and Lafayette W. Blymyer, Los Angeles, Cal. In a device of the class described, the combination of a sign base provided with an aperture with a notch in the edge thereof, of an electric



light receptacle and a locking member carried thereby, said member engaging the edge of the aperture at said notch by a rotary movement and pressing said edge on the inner side and outer side to lock said receptacle thereto.

979,905. Electric Sealing Device. Johann G. Wallmann, Oakland, Cal., assignor of one-half to Edward Pierce, Oakland, Cal., In an electric sealing device, the combination of a tube having a lower portion and a contracted upper portion,



a cap supporting a seal removably secured to the lower portion of said tube, a casing having a head containing a longitudinal opening and surrounding the upper portion of said tube and projecting over the lower portion thereof, a drum in said casing, and current conducting means leading into said casing and encircling said drum.

INDUSTRIAL

TYPE C WATTHOUR METERS.

The latest developments in the design of watthour meters are represented in the type C meters built by the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa. These meters operate on the induction principle, which experience has shown to be in all respects the most satisfactory principle for alternating current meters, and are the result of a gradual evolution, covering a period of years, in which exhaustive experiment and intelligent study have played an important part.

The driving torque of the meter results from a shifting magnetic field acting on an aluminum disk. The shifting field is produced by the line current in a low resistance series coil and current in a highly inductive shunt coil connected across the line voltage. These coils are mounted on a laminated iron magnetic circuit of special design.

The design of the electromagnetic circuit is one of the most important factors in the operation of the meter. In the type C meter the circuit is closed on itself and therefore self-shielding, making the meter independent of stray fields. The arrangement is also such that most of the flux produced by the voltage coil passes through the gaps, only a leakage component combining with the series flux to produce rotation. This feature renders the meter accurate over a wide voltage range, by reducing the effect of varying permeability of the iron at varying voltage, and also prevents shunt field damping at high voltage, a serious defect in some types of meters.

The light load adjustment loops produce sufficient unbalance between the two limbs of the voltage flux to cause a friction compensating torque. Owing to this position of the no-load adjustment loops, however, this adjustment is entirely independent of current.

A feature of the Westinghouse meters is the micrometer light load adjustment. The position of the micrometer screws at the bottom of the meter element makes them accessible. The micrometer feature makes possible accurate adjustmnts.

Taken altogether, the combination of freedom from current effect, possibility of micrometer adjustment and accessibility, make an ideal light load device, free from creeping and having maximum accuracy.

The positive full load adjustment is another striking feature. The two retarding magnets are mounted on a heavy brass U-strap, the ends of which slide in machined ways in the mounting frame. This arrangement makes it impossible to twist the magnets out of alignment in tightening the clamping screws. Two clamping screws at each end of the U render the adjustment permanent in spite of shocks and jars.

The jewel and pivot type of bearings has been entirely eliminated in Westinghouse watthour meters. Instead a highly polished and specially hardened steel ball working between two cup jewels is used. As it is impossible to make the center of gravity of the moving element exactly correspond with the center of the bearing, the shaft has a slight gyratory motion which gives a rolling action to the ball. This produces considerably less friction than the boring action of the jewel and pivot and, by presenting constantly new bearing surfaces, assures an extremely long jewel life and permanent light load accuracy.

Permanence of full load accuracy is assured by the special aging treatment given to the retarding magnets and by the protection afforded by an iron shield between the permanent magnets and the electromagnet, which prevents any bad effects from the heavy fields produced by overloads.

The entire meter element is carried on a cast iron mounting frame so that it can be removed from the case as a unit without disturbing any adjustment. This allows adequate inspection in case of trouble and makes all parts accessible for repairs.

The full load torque of the type C meters is 42 millimeter-grams per phase and the weight of the moving element is only 15 grams per phase. This gives the high ratio of torque to weight of 2.8. The lightness of the moving element further insures long life of bearing jewels. The voltage coil is approximately 1.4 to 1.8 watts per phase at normal voltage, and the series coils produce a drop of .4 volt at full load.

Every meter has a guaranteed accuracy within 2 per cent, or from 2 per cent of full load to 50 per cent overload. This permanence of the meters is so reliable that these limits can be depended on even after shipment. No adjustment is necessary at installation nor need the case be opened to remove supporting wedges or release the movement. For this reason separate terminal chambers are provided for making connections, retaining the original seals on the meter element. This not only preserves the Westinghouse guarantee of accuracy, but prevents dust entering the meter at installation.

Type C meters are built in all forms demanded by commercial needs. House service meters, both single-phase and polyphase, with metal or glass covers, prepayment meters and single-phase and polyphase switchboard meters with metal and glass covers are described in the Westinghouse Company's publication No. 1137, just published. This publication also goes into the general principles of operation of watthour meters, and should be of interest to all those having to do with this class of apparatus.

THE NEW "IRONCLAD-EXIDE" BATTERY.

In line with its policy of progressiveness, the Electric Storage Battery Company of Philadelphia has recently developed a new electric vehicle battery, which will be placed on the market in 1911. This new battery will be called the "Ironclad-Exide" and is the latest and highest development of the "Exide" battery. It is the result of years of study and experimentation and long tests already made have proven its dependability.

The "Ironclad-Exide" battery is the perfection of a battery first invented by a Frenchman. The Electric Storage Battery Company secured the American rights on this patent about four years ago, and since that time has been carrying on experiments in an endeavor to perfect it. This has now been accomplished and under severe tests has shown the most satisfactory results.

The new "Ironclad-Exide" positive plate is so designed as to effectually prevent the loss of active material. The plate consists of a metal conducting top and bottom bar connected by vertical conducting rods. Each rod is surrounded by active material, which in turn is protected and held in place by a slotted hard rubber tube. This tube carries a vertical rib on each side which takes the place of wood separators, used with the standard "Exide" type of positive plate and makes the use of rubber separators unnecessary. A thin flat wood separator spaces the positive from the negative. The negative plate is a modified "Exide" negative plate thickened and improved, to enable it to withstand, not so much the increased capacity, as the truly unprecedented life of the new positive plate.

The "Ironclad-Exide" battery is claimed to give from two and one-half to three times longer life. The active material does not shed from the plates which eliminates the necessity

for ever cleaning the cells. It gives increased mileage and maintains this high capacity during the greater part of its life. Furthermore, it can be installed in standard "Exide" battery jars so that vehicle users having "Exide" batteries can substitute the new battery when requiring renewals.

This announcement of the Electric Storage Battery Company, the oldest and largest battery maker, which has devoted 23 years to the study and maintenance of storage batteries and a company whose recommendations, in this field have always been conservative, should be of special interest to every electric vehicle maker, agent or user.

LARGEST HYDRAULIC TURBINE.

The engineering world will be much interested to learn that contracts have recently been awarded for the building of two hydraulic turbines, which will be the largest in the world. The Stone and Webster Engineering Corporation acting as consulting engineer for the Pacific Coast Power Company has placed an order with Allis-Chalmers Company for two 20,400 h.p. reaction turbines to be installed in connection with a new development on the White river.

This development is one of the most comprehensive undertaken on the Pacific Coast and the problems which have confronted the engineers have been extremely interesting as well as complex. The White river is fed by the glaciers of Mt. Rainier and receives its name from the milky silt which the river carries and which gives it a whitish color.

The development is about twenty miles east of Tacoma. The diversion dam is to be built at a point near the big viaduct of the Northern Pacific Railroad north of Buckley. This will not be of unusual size or strength and will simply serve to divert the water into a ditch discharging into a settling pond in which the silt will have a chance to be dropped. The headworks and gates will present some new features of design and will be made extremely strong. From the diversion dam the water will be carried through an earthen ditch about five miles long to the main storage reservoir. This storage reservoir is one of the most important elements in the entire development as it will hold enough water to operate the plant for a period of three or four months should no additional water be received. It is to be made up of several existing lakes which will be interconnected and which will have their capacities largely increased by the building of heavy embankments and masonry dams. The flow line of the reservoir will be about four miles long.

From the storage reservoir the water will be carried through a tunnel about 3000 feet long to the head basia. At present only one tunnel will be built but eventually another will be added. From the head basin a separate steel pipe line will be built for each turbine. These lines will be approximately 2200 feet long and will be eight feet in diameter at the upper end and six feet in diameter at the power house end

The power house is designed for a total length of approximately 373 feet; 45 feet 7 inches of its width is to be used for the generating units which will be placed along this section with their shafts in line. Room is to be provided for six units although only two will be installed at the present time. The other side of the building, 26 feet wide, will be given over to exciter units, pumps, toilet rooms and transformer bays. Concrete foundations will be employed with brick superstructure.

The hydraulic installations will be supplied by Allis-Chalmers Company and will consist at present of two units, the largest ever built. These will have a maximum capacity of 20,400 h.p., each under a head of 480 feet. They will run at [illegible] r.p.m. Each turbine will be direct connected to a 60 cycle, 3 phase, 6600 volt generator.

The turbine runner is of the high pressure Francis type with horizontal shaft. Water will be admitted to the runner through a cast steel spiral casing. The runner, which will also be of cast steel, divides the water into two lines of flow and it is discharged from the wheel by two quarter turns to separate draft tubes. The flow of water to the turbine will be controlled by a cast steel butterfly valve.

In a turbine which exceeds all previously built, in point of both size and power, it is quite natural to find many parts that are larger or stronger than anything of the kind now existing.

The spiral casing of this turbine will be the largest steel casting of this kind ever made. The butterfly valve is to be over seven feet in diameter, and will be the largest valve of this type ever used. The shaft, carrying the turbine runner, will be nearly two feet in diameter and the bearings for it will be about 16 inches in diameter. All parts of the turbine which will have to withstand the operating pressure of the water will be tested in the shops under a pressure corresponding to about 900 feet head. To give an idea of the size and strength of the parts it is only necessary to state that the total testing load on the butterfly valve will be about one and one-half million pounds.

The governors for these turbines will be of Allis-Chalmers standard oil pressure type and the specifications call for extremely close speed regulation. Separate governors will be supplied for each unit but a rather elaborate central oil pressure system will be employed.

As this plant will have to regulate the supply of energy to the whole system of the Pacific Coast Power Company the problem of proper regulation is an important one. It becomes of still greater importance on account of the necessity of conserving the storage supply of water. To meet this condition and handle the water in a way which will protect the plant from injury and at the same time save water, pressure regulators will be installed. These are similar in design to those Allis-Chalmers Company is now installing on the 18,000 h.p. turbines in the Great Western Power Plant, a design which has done excellent service on other installations.

The size of the exciter units has not yet been definitely determined, but there will be two of at least 500 h.p. each. One exciter is to be provided for each three units of the ultimate equipment. As the proportionate amount of water which these wheels will use is not large they will be of the impulse type and will be governed by means of a deflecting hood similar to that used with the exciter units of the Kern River No. 1 station of the Edison Electric Company, built by Allis-Chalmers Company.

Construction is progressing rapidly under the direction of the Stone and Webster Engineering Corporation. Mr. S. L. Shuffleton, the Western representative of this organization, is in direct charge.

A REMARKABLE CABLE.

The Pacific Coast department of the Standard Underground Cable Company has received a sample of cable which has a very interesting history. The cable was manufactured at the Pittsburgh, Pa., factory of the Standard Underground Cable Company in 1886 and was installed in the city of Philadelphia in May, 1886. The cable was sold and manufactured for 600 volts working pressure and was operated at that pressure for several years when the working voltage was increased to 2000, at which voltage the cable was operated for several years and until a change in the system necessitated taking it out of service in September, 1910, after the cable had been in continuous service for twenty-four years and four months. The copper, insulation (fibre saturated with Ozite compound), lead and outer covering of saturated braid, are all in excellent condition and appear to be practically as good now as the day the cable was first placed in service over twenty-four years ago.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Yosemite Power Company has been incorporated by John Hays Hammond and others with a capital stock of $10,000,000.

EUREKA, CAL.—The Eel River and Southern Telephone Company has been incorporated by H. D. Smith, E. M. Loveland, R. M. White and others with a capital stock of $20,000.

FINANCIAL.

ONTARIO, CAL.—The City Council has awarded the contract to the First National Bank of Ontario for the $95,000 worth of the $175,000 water bond issue.

ELLENSBURG, WASH.—The people of the city of Ellensburg, have voted in favor of a municipal water system for Ellensburg. The estimated cost is $300,000.

FALLS CITY, ORE. The city will hold a special election on Monday, January 2, to vote on the proposition of bonding the city for $25,000 for a municipal water system.

SILVERTON, ORE.—The question of voting bonds to pay for the construction of a waterworks and sewerage system will be put up to the citizens and taxpayers of Silverton next week.

SIERRA MADRE, CAL.—By a vote of 123 to 20 the citizens of this city today voted to issue $40,000 municipal bonds to increase the water supply and establish a system of fire protection.

TURLOCK, CAL.—The town trustees have awarded $25,000 municipal sewer and waterworks bonds to N. W. Halsey & Co. for the sum of $23,025 the bid was accompanied by a certificate of deposit for $2,502.50.

SANTA ANA, CAL. Another bond election will be called by the City Trustees for $35,000 with which to increase the pumping capacity of the city water station About $3000 will be used for a well; $16,000 for a new pump and about $16,000 for strengthening reservoir walls.

ELLENSBURG, WASH. By a vote of 7 to 1, the citizens of Ellensburg voted their approval of the council's scheme for installing a municipal water system in Ellensburg. The cost of the underaking is $300,000 and will be paid in bonds issued against the system and paid by 75 per cent of its gross income.

SAN FRANCISCO, CAL.—The public utilities committee of the Supervisors at a recent meeting set January 30 as the date for selling the initial installment of water bonds Of the $1,125,000 realized through this sale $600,000 will be paid to William Ham Hall for the Lake Eleanor and Cherry Creek properties.

KINGSBURG, CAL.—At the regular meeting the City Council canvassed the bids submitted for the water bonds and the bonds were awarded to Adams & Co. of Los Angeles, whose bid was par, accrued interest and $254 premium and in addition to this they will print their own bonds. The lowest bid was par, accrued interest and a premium of $2.08.

SAN FRANCISCO, CAL.—The Supervisors at last week's meeting adopted a resolution by unanimous vote authorizing the sale of $1,125,000 of water supply bonds out of the $45,000,000 authorized to be issued to cover the entire cost of the city's Sierra water project. Bids for these bonds are to be submitted and opened on January 30 next, while six months later an equal amount will be offered for sale, and a year later another block.

TRANSMISSION.

CHICO, CAL.—President A. F. Smith of the Sacramento Valley Power Company announces the sale of a half interest in that corporation to the Fleishhacker Bros. at a price not made public. The company will be re-incorporated with a capital of $2,000,000, and bonds for an equal amount will be issued.

STAYTON, ORE.—A. L. Shreve, proprietor of the Stayton electric light plant, has purchased a power site three miles up the Santiam river from Stayton. The site is capable of generating about 5000 h.p. It is Mr. Shreve's plan to clean out the drift, build a headgate and do considerable other preliminary work this winter and in the course of a year or two build a big, modern power house on the site, which is on the north side of the river.

RED BLUFF, CAL.—A. G. Simpson of Chico has filed an appropriation of 8000 miners' inches of the water of Deer Creek. The purpose of the appropriation is to generate electric power. The power plant will be erected about 15 miles east of Vina. The water will be carried in a ditch 20 feet wide across the top, 14 feet wide at the bottom and 6 feet deep.

PORTLAND, ORE.—Dan. J. Malarkey, senator from Multnomah county, will introduce a bill creating a public service commission in the session of the Oregon legislature, which will convene at Albany early in January. The act will be one of the first measures presented for the consideration of the senate, and will provide means for the regulation of street car transportation, power, light, water, telegraph, telephone and all other corporations selling their goods to the people while making use of some of the property of the people. The bill will be modeled somewhat after the law now in operation in the State of New York, but it is not intended to divide the State into districts.

TRANSPORTATION.

FRESNO, CAL.—S. N. Griffith announces that he has withdrawn, with his associates, from the field as supporter of the proposed electric railroad between Clovis and this city. Failure to secure franchises desired from the city of Fresno is the reason Mr. Griffith gives for his action.

STOCKTON, CAL. Having completed the grading between French Camp, a short distance outside of the Stockton city limits, and Modesto, the San Joaquin Electric Railway has applied for a franchise over McKinley avenue, which reaches the water front, and would give the new line considerable through freight business.

OAKLAND, CAL.—F. M. Smith says: "So many misleading articles have appeared in the press during the last few weeks that I think it best to correct them. While it is true that I have purchased from F. C. Havens and W. G. Henshaw their holdings in the Oakland Traction Company and Key Route and that I have sold to Mr. Havens my holdings in the Peoples Water Company, it is not true that I have sold any of my transportation interests to the Santa Fe Company nor have I had any negotiations with that company to that end. My plans are to give the cities on this side of the bay as fine a street car system and ferry system as brains and money will provide. I cannot at this time state in detail just what plans for such development have been determined on."

OROVILLE, CAL.—Announcement has been made at the office of the Western Pacific Railway that a traffic agreement has been signed between the Western Pacific and the Monticello Steamship Company and the San Francisco, Vallejo and Napa Valley Electric Railroad, whereby there will be an interchange of tariff between the local road, the steamship line serving Vallejo and the Mare Island Navy Yard and the electric line which extends from Vallejo thirty-five miles into Napa Valley.

SAN FRANCISCO, CAL.—Rails and other steel work of the Geary street municipal road will begin to arrive in March and construction work will start. This is the announcement made by Chief Assistant City Engineer H. D. Connick. The specifications for the side plates, connecting rods, trolley poles and wires will be reported to the Board of Public Works during the present week. There will be about 10,000 tons of metal in these side materials. In the steel rails there will be 2570 tons. About 70 tons of the steel rails have been turned out, including nearly all the curve connections. Engineer Connick says the curve connections will be much better than those of the United Railroads, for the reason that they will be made of manganese steel, which is more durable than the ordinary metal. It is not considered feasible at the city engineer's office to equip the Geary street line with the newly invented Edison storage battery cars. It is believed that the cars are somewhat in the experimental stage at present. Engineer Connick says it is proposed to secure for the city road coaches constructed entirely of steel, of the most improved type somewhat larger than the largest of the United Railroads cars, and fitted for a "pay-as-you-enter" system.

ILLUMINATION.

WILLOWS, CAL.—A franchise granting power to erect poles and stretch wires in the town of Willows for the purpose of carrying electricity for commercial purposes, has been sold to C. R. Wickes.

HOOD RIVER, ORE.—The Hood River Electric Light, Power & Water Company has been sold to the Oregon and Washington Electric Corporation, which is buying up power plants around this section, having recently secured the Vancouver plant. It is said the price paid for the Hood River corporation is $70,000, the purchaser to assume the bonded indebtedness, amounting to as much more.

BOISE CITY, IDAHO.—The Telluride Power Company, the Great Shoshone Falls Light & Power Company and the Boise Power, Light & Traction Company, are seeking to gain control of the electric power business of Southern Idaho. The Telluride Power Company is prepared to spend several million dollars in the completion of its Idaho plans. A. L. Woodhouse, general superintendent, was in Boise several days ago, accompanied by a party of engineers. The main power plant of the Telluride Company will be constructed near the confluence of the Malad and the Snake Rivers, and will furnish 10,000 h.p. to a line to run east and west across Southern Idaho. The Shoshone company is backed by Kuhn Bros. Its plant is on the Malad River at Salmon Falls. It arranged to run a line west through Southern Idaho, and to meet the competition of the Telluride Company at Boise. The Boise Power, Light & Traction Company filed articles for $1,000,000, half of which amount it is said has been subscribed in preparation for construction of a power plant on the Payette River above Horseshoe Bend and for extension of lines. The plant will develop 5000 h.p. and will cost $500,000.

LOS ANGELES, CAL.—The new electric power plant has been completed at Redondo Beach by the Pacific Light & Power Company at a cost of $1,000,000. The new plant is more than twice as large as any similar institution west of New York, generating 65,000 h.p. The plant was constructed to relieve the congestion in Los Angeles, as well as forming a source for further extension of the Huntington and Pacific Electric properties. The power generated will be sufficient to give the downtown sections better service during the hours of heaviest traffic. The new plant is the expansion of the original power house at Redondo Beach, constructed three years ago, with a capacity of 25,000 h.p. The rapid growth of the electric lines intended for the use of this power was so great that by the time the plant was completed the demands of the electric lines and accessory uses were so extensive that the engines were run constantly at capacity. The power of the new plant will be distributed between the Pacific Electric and Los Angeles Railway companies. The Pacific Electric Company has arranged with the Pacific Light & Power Company for a supply of power which will continue by contract for several years. With the Redondo plant the corporation is producing in its various power houses in this State over 120,000 h.p.

WATERWORKS.

RATON, N. M.—The contract for the installation of the new Cimarron waterworks system has been let to Cook & Co. of St. Louis, Missouri, for $32,000.

COLVILLE, WASH.—Lewis P. Larsen has been granted a franchise to install and maintain a system of waterworks in Metalline Falls and the right and privilege also to build and operate a telephone and electric light system.

LOS ANGELES, CAL.—The Board of Supervisors will receive sealed bids up to January 30th for a franchise granting the right to lay down and for a period of 40 years to maintain a system of water pipes in the townsite of Lankershim.

TACOMA, WASH.—The Council has passed an ordinance providing for the construction of water mains ranging in size from 6 inches to 12 inches in Local Improvement District No. 564 in the city of Tacoma and cost of which is estimated at $38,555.

TACOMA, WASH.—Two bids have been rejected by Commissioner Nicholas Lawson of the department of light and water for the construction of the 100,000,000 gallon storage reservoir for the city's Green River gravity water system. Both were rejected because they were above Project Engineer J. R. Preble's estimate, which was $310,000.

BRAWLEY, CAL.—At the Council meeting last week plans and specifications for waterworks were accepted with slight modifications. Bids will be called for at once. The waterworks plan calls for a complete system but bids are arranged in such a way that the Brawley Water Company may have an opportunity to dispose of a portion of its 2 and 3 inch pipe on a competitive bid.

FREEWATER, ORE.—Freewater's proposed water system, plans for which have been under way for several months past, is soon to be a reality, the construction contract being signed by Mayor J. H. Hall at a special meeting of the Council, calling for the completion of the work by May 1, 1911. J. H. Jager, representing a St. Louis firm, has agreed to install the water system for $14,340, and take the city's recent bond issue of $16,500 at par.

FOREST GROVE, ORE.—The City Council has made a contract with O. B. Gates of Hillsboro by which he takes the surplus water of the Forest Grove Water system for a term of 10 years, at 4 per cent 1000 gallons. A pipe line will be built from the Forest Grove reservoir to Hillsboro and Cornelius and Mr. Gates will try to secure franchises with these two cities and with the people along the proposed right of way to supply the needed water.

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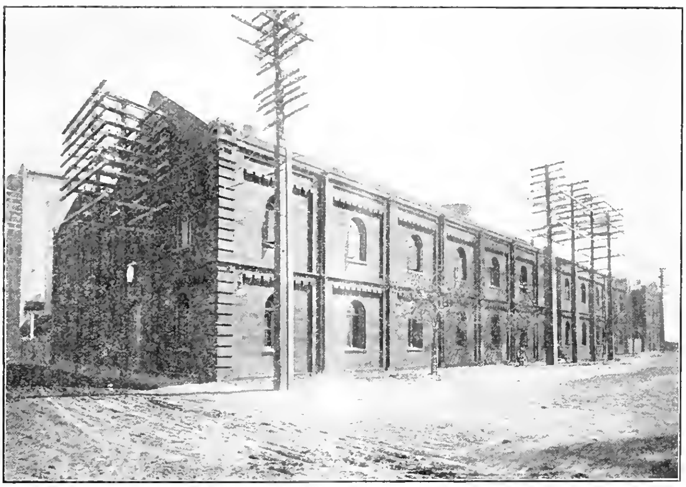
RECONSTRUCTION OF OAKLAND STATION

BY C. F. ADAMS.[1]

The brick station at the corner of First and Grove streets in Oakland has just completed a chapter of its history. For twenty years it was a steam station, and a model of its kind. Now it is the terminus of a transmission line and the distributing centre of Oakland's power and light service.

When the first alternating-current dynamo was purchased for this station a few years ago, a 75-kilowatt machine was considered large enough to supply the demand for years to come. The street lamps were then operated by direct current arc dynamos, and the entire equipment was belt driven. Slow-moving Corliss type engines were the motive power, and long counter shafts with friction clutches were used to drive the group of machines. When alternating current motors became a reality, larger generators were required and finally the station equipment consisted of three 500-kilowatt generators, one 875-kilowatt motor generator, one 150-kilowatt, and one 250-kilowatt motor generator sets. Three horizontal compound engines were in use and one vertical compound engine with direct-connected generator. The original arc lamps had all been superseded by alternating current arcs, operated from constant current transformers.



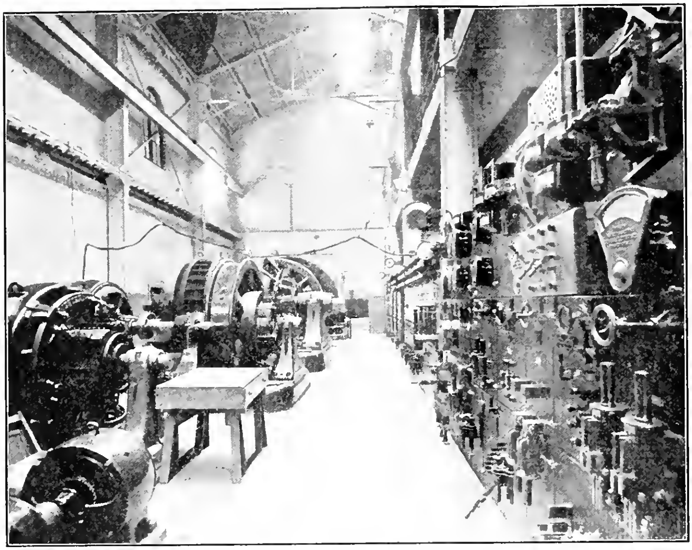
Station A, First and Grove Streets, Oakland.

In 1908, after a careful inspection of the station, a general reconstruction was advised in order to place the Oakland service on a permanent high grade basis.

The old station had wooden upper and main floors, as well as a wooden roof. The brick walls bore traces of April, 1906. The total steam equipment had been superseded in service by the single 9,000-kilowatt turbine in the new Station C. The south end of Station B had been used for some time as a pipe shop. The high tension transformers were in a galvanized and wood frame structure, known locally as "the tin can." The switchboard was partly in the transformer room and partly in the gallery of Station A. The plant as a whole was outgrown and a bad fire risk. The new arrangement proposed was to remove all combustible material from Stations A and B. All the high-tension transformers were to be moved to Station B, and the iron building abandoned. All the switchboard apparatus, regulators, and arc transformers were to be combined in Station A. Provision was to be made for a future underground service to be run from this station, which would dispense with all the overhead wires to the business district and thus avoid the fire risks to the line and the consequent interruptions.

During this work all service would have to be

[1] Engineer of Electric Construction, Pacific Gas & Electric Company.



Main Floor, Station A, Oakland.

Main Floor, Station B Oakland, Looking Toward Station A.

maintained without interruption and the building work would have to be completed before the winter rains came.

The old switchboard was maintained in service during construction, as its location on a side gallery was not disturbed by the building changes. Wooden shelter houses were built over the motor generators to protect from dust and falling debris. The driving belts and rope transmission were removed. Machinists with sledges and chisels tore out countershafts and engines piecemeal, and the work was on. Then the wooden roof was lifted and the blue sky let in. Old foundations were blasted out to make room for new, and for months the place was the scene of turmoil and labor, day and night. Junk men, vultures of commerce, flocked about and viewed the spoil, and the wreckage went to the highest bidder.

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Station B was the first to take form. A steel frame secured to the brick walls supported the new steel roof. A concrete gallery for the 6000-volt switches and a concrete floor for the transformers completed the building work. The 875-kilowatt motor generator was moved into Station A. The high-tension lines were brought in, and the transformers were soon shifted and in service.

The new station is roomy and light. All conductors from transformers to switchboard are placed underground. The 60,000-volt switches for transformers are automatic and solenoid operated. They are controlled from the main switchboard.

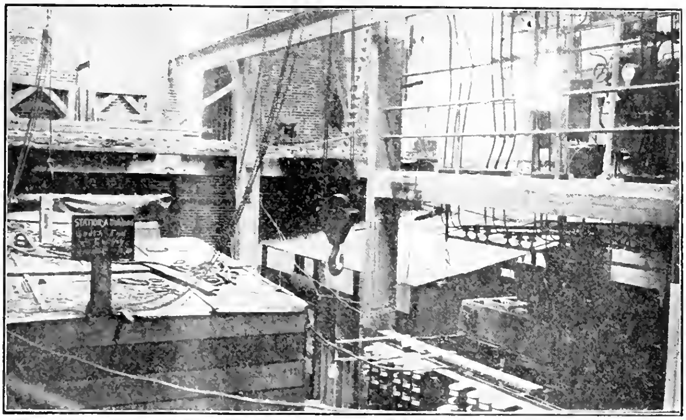
The work in Station A was of greater magnitude. A 1000-kilowatt generator was erected to operate the street railroad load. Two steam engines with shafting and generators were completely dismantled. The 250-kilowatt motor generator set was shifted to Elmhurst, a smaller set was sent to Sacramento, and one of the 500-kilowatt alternators was forwarded far up the canyon of the American River to run some gold dredgers. A new exciter set was procured and a 200-kilowatt motor generator for the all-night, direct current service. Provision was made for a storage battery, and the necessary "booster" and switchboard were installed.

A double bus concrete cell structure was built to contain all oil switches. Duct lines were run to

all power transformers, motor sets, and to enclose the main commercial feeders. A complete new switchboard was built to control all station apparatus and lines, including the turbines and exciters in Station C.

A gallery of concrete and steel was constructed to extend the length of the building and support arc tube, feeder regulators, and mains.

All wiring was to be supported on metal frames or within metal conduit.



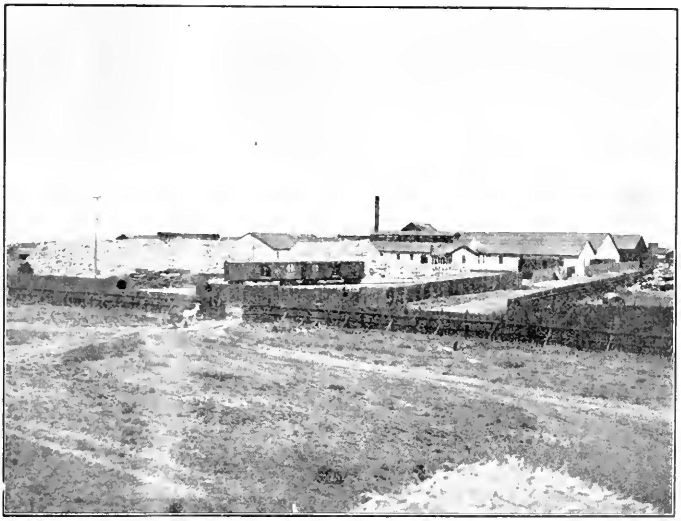
Interior of Station A during the reconstruction work, when the roof was off the building but the station in regular operation. The nearer box-like structure was the temporary protective covering for a 1000-kilowatt motor generator set; and the one on the right covered a 1000-volt bus.

The illustrations convey the story of what the station is now, but no views are available to show the old station. Not a single serious accident occurred through the entire reconstruction, neither loss of life nor personal harm and there was no greater average of service interruption than was normal to the old station. The entire work, planned and executed by the engineers and construction forces of the Pacific Gas & Electric Company, represents an outlay of approximately $150,000.

ELECTRICITY APPLIED TO PAPER-MAKING.

BY ARCHIE RICE

Contra Costa is the foremost manufacturing county of California. But comparatively few people know this. It has the largest oil refineries in western America, the second largest dynamite factory in the world, the largest smelting and lead works on the Pacific Coast, a large copper smelter, a large steel mill, a big sugar refinery, powder works, rubber works, a big paper mill, and numerous minor industries scattered along or adjacent to its extensive bay and river frontage.



Pacific Paper and Board Mills Plant, Near Antioch, California.

The town of Antioch stands on the bank of the San Joaquin River, near where that stream empties into the upper reaches of San Francisco Bay. Close to Antioch is the plant of the Pacific Paper and Board Mills. It is the only concern of its kind on the Pacific Coast, and supplies the western territory as far eastward as Salt Lake City.

In the operation of this paper factory electricity from the lines of the Pacific Gas & Electric Company is used to drive all motors, ranging from 5-horsepower to 400-horsepower each. Most of the motors are from 50 to 75-horsepower.

The factory employs one hundred and twenty men, and produces an average of from thirty to forty-two tons of paper a day. Its principal products are pasteboard of various thicknesses, wrapping paper of different kinds, tissue paper, and straw-board used for egg cases.

The raw material for these products looms high in imposing pyramids in the yards adjacent to the works. One pyramid of recent construction consisted of some four thousand bales of wheat straw hauled in from the grain fields of Contra Costa County. Two other pyramids each contained about two thousand bales of old paper of nearly every conceivable description. Another pyramid consisted of bales of old

jute sacks, twine, fragments of burlap, and similar material. Then there were a half dozen great piles of old copies of the different San Francisco newspapers, eastern magazines, discarded telephone directories by the thousand, and heaps of circulars and placards that had never been used. Also there were large quantities of cottonwood timber, to be crushed to fibre and later soaked into plastic pulp.

Two of the 2000-bale Pyramids of Old Paper to be Made Into New.

The cottonwood fibre, or wood fibre, as it is commonly called, is the basic principle of the heavier tough papers having a parchment-like texture.

In the process of making paper there are some seven stages through which the substance passes while being converted from old scrap paper into smooth new stock. Ordinarily it takes six hours for the evolution from scrap heap to stock pile. A longer time is required in the making of strawboard for egg boxes and in the production of tissue paper, as the pulp for these two products has first to undergo a cooking process. Also, before the old burlap, jute, and twine can be converted into pulp it is washed and treated chemically to remove foreign matter.

The pulp condition is the first stage in paper-making. Great vats are filled with bits of old paper and the mass slowly and steadily revolved until it assumes the consistency of a soft mush. This mush is drawn off in pipes and allowed to flow upon an endless blankett. This blanket is 122 inches wide, 122 feet long, and made of the finest wool. It passes over and between large spool-like drums. The pulp accumulates like scum on a mill pond, steadily assuming homogenity, closeness, and a uniform thickness to the width of the blanket, 122 inches. As the water is gradually pressed out and the film of paper assumes consistency it is separated and passed on through other sets of rollers, drying in transit over big brass drums, and finally smoothed and ironed between highly polished, chilled-steel cylinders.

Paper is made in an unending strip, or ribbon, 122 inches wide, with a deckeled edge where it reaches the sides of the blanket. While the completed end of the paper is coming out of the ironers and being cut into the desired lengths, not 200 feet back on the ribbon the substance is only a very thin, soft scum without power to hold together unsupported.

As different grades of paper are required the lot is evolved in one long ribbon. And when the next order takes its turn there is a blending of the two grades or shades of paper at that point. But the ribbon goes right on, passing from one stage to another, without a break. Today a thick gray board to be cut up to form the covers of school books, tomorrow a thin, tough, yellowish paper to be used in wrapping packages in stores.

Tissue paper is made in the same long ribbons and of the same huge width, and then cut up into the sizes desired.

Ordinary paper in its completed form is subjected in the factory office to three tests: (1) To determine its tensile strength; (2) to determine if it have the desired weight; (3) to determine if it have the desired thickness. The tensile strength is tested by means of a remarkably sensitive little instrument using air pressure upon a portion of the paper about the size of a dime. This pressure is gradually applied until the paper bursts, and the instrument records the pounds pressure attained. For instance, tissue paper can stand a pressure of about four pounds to the square inch, while some of the wrapping papers can take considerably more than one hundred pounds, and the thick, slate-colored board can withstand a pressure far beyond the power of the instrument to record. Tensile strength proves the toughness of the fabric, and the other tests, for weight and thickness, insure uniformity in the particular grade of paper called for by the contract.

WIRELESS FROM AN AEROPLANE.

An interesting series of experiments with the wireless telegraph planned for the aviators' meet at San Francisco, January 7-14, 1910, were prevented by the wreck of Hubert Latham's "Antoinette" on January 10. Up to the time of printing this page it has not been possible to perform them, though they may be accomplished under the direction of Paul W. Beck, Lieutenant U. S. Signal Corps, and E. E. Ennis, expert with the Western Wireless Equipment Company. The sending instrument to be employed weighs but 8 oz. and is attached to the aviator's wrist. The guy wires on the machine are used as a static ground, "earthing" being accomplished by induction, no physical connection being practicable. The antennae consists of 120 ft. of No. 6 aluminum wire, weighing two pounds, suspended from the guy wires of the aeroplane.

NEW WATER POWER REGULATIONS OF THE DEPARTMENT OF AGRICULTURE.

Signed by the Secretary, Dec. 28, 1910

Water-power Permits.

Reg. L-1. Preliminary water-power permits will allow the occupancy of the lands of the United States within National Forests for the purpose of securing the data required for an application for final permit and for such construction as may be necessary to preserve water appropriation during that period. Final water-power permits will allow the occupancy and use of such lands for the construction, maintenance and operation thereon of works for the main purpose of the generation of electrical power. Preliminary or final permits for commercial water-power works, or for non-commercial water-power works of a capacity in excess of one thousand (1,000) electrical horsepower, will be granted, extended and renewed only by the Secretary of Agriculture. Permits for non-commercial water-power works of a capacity of one thousand (1,000) electrical horsepower or less, and for transmission lines, not a part of any water-power works covered by a water-power permit will be granted, extended and renewed by the District Forester. The Secretary of Agriculture alone may revoke water-power permits.

Non-commercial and Commercial Water-Power Works.

Reg. L-2. The term "non-commercial water-power works" will be applied to water-power works owned and used solely by the permittees for one or more of the following purposes: In the operation of their own mines, or in the milling and reduction of ores therefrom; as auxiliary to irrigation works owned and operated by permittees; temporarily, in the construction of other works for which permission has already been granted the permittees; or by municipalities for municipal purposes, or such other miscellaneous uses not herein enumerated as may be determined by the Secretary of Agriculture to fall within this class. No charge will be made for the use and occupancy of lands for non-commercial water-power works. All other water-power works will be termed "commercial" (see Regulation L-7 for charges).

Priority of Application.

Reg. L-3. Priority of application for a preliminary water-power permit shall be established by filing an application as prescribed in Regulation L-9. Priority of application for a final water-power permit shall be established by filing an application as prescribed in Regulation L-10. If an application for a final permit as prescribed by the said regulation is filed within the period required in a preliminary permit, priority established thereunder shall be maintained, and with reference to priority such application for final permit shall relate back and be effective as of the date of the application for the preliminary permit. Priority shall be maintained only when the projects shown in the application for the final permit are within the approximate limits of diversion and discharge as shown in the application for the preliminary permit; priority shall be established for any projects outside these limits from the date of filing the application for final permit. Priority established under an application for final permit shall be lost if the applicant fails to return a duly executed stipulation, as prescribed in Regulation L-12, within (90) days from the date it is mailed by the District Forester, unless such period is extended by written authority of the Secretary of Agriculture. Priority established under an application for preliminary permit shall be lost if the application for final permit, as prescribed in Regulation L-10, is not filed within the time required in the preliminary permit.

Priority established under an application for final permit shall be lost if the permit is revoked. No other application for a like use, covering in whole or in part the same lands, shall be accepted from the permittee whose priority of application is lost until the expiration of one year thereafter.

Exclusive Use and Occupancy of Lands Under Permit.

Reg. L-4. No application for preliminary or final water-power permit will be accepted, and no permit will be granted thereunder while the lands applied for are occupied and used under an existing water-power permit. Upon ascertaining that the lands applied for are so occupied and used, the District Forester will return the application and inform the applicant fully of the reasons why the application can not be accepted.

Water Rights.

Reg. L-5. Occupancy and use of National Forest lands is the sole privilege granted under a water-power permit. In the issuance of such permits no attempt will be made to adjudicate water rights since water rights are acquired under state laws and adjudicated by the courts. Therefore, no protests against the granting of an application, if based upon alleged lack of water rights will be considered; nor, in general, will any allegation that the time of beginning or completion of construction has been, or is delayed by litigation over water rights be accepted as a sufficient reason for granting any extensions of time.

Term of Permits.

Reg. L-6. Unless sooner revoked by the Secretary of Agriculture, a final water-power permit shall terminate at the expiration of fifty (50) years from the date of the permit, and may then be deemed to be an application by the permittee for a new permit to occupy and use such lands as are occupied and used under the original permit: Provided, that the permittee shall, not less than two nor more than four years prior to the termination of the permit, formally notify the Secretary of Agriculture that it desires such new permit, and will comply with all laws and regulations at such time existing, regulating the occupancy and use for water-power purposes of lands of the United States within the National Forests.

Charges.

Reg. L-7. The occupancy and use of lands of the United States within National Forests under a preliminary or final water-power permit, other than non-commercial, shall be conditioned upon the payment of an annual charge, based upon the value for power purposes of such lands, and the measure of said value shall be the net power capacity of the works, as defined in Regulation L-8, and the rates at which the charge shall be calculated shall be for each net electrical horsepower per annum as follows:

For the 1st year	0.10 dollar
For the 2nd year	0.20 dollar
For the 3rd year	0.30 dollar
For the 4th year	0.40 dollar
For the 5th year	0.50 dollar
For the 6th year	0.60 dollar
For the 7th year	0.70 dollar
For the 8th year	0.80 dollar
For the 9th year	0.90 dollar
For the 10th year and each succeeding year	1.00 dollar

The above rates per net electrical horsepower per annum shall apply to preliminary water-power permits, in accordance with the net power capacity of the works as estimated at the time of granting the preliminary water-power permit, and if the final application is made in accordance with the terms of the preliminary permit all payments made under the preliminary permit shall be credited to the permittee and be applied to the payment due at the time of granting the final permit and/or to payments to become due thereafter: Provided, however, that if the final permit provides for only a partial development of the project or projects protected by the preliminary permit then only a proportional part of such payments as may have been made under the preliminary permit will be applied on payments due or to become due under the final permit.

The above rates shall also apply to final water-power permits, and if the works are completed and operation is

begun within the time specified in the stipulation executed by the permittee or any approved extension thereof all payments made prior to such specified date under the final permit and all payments which have been credited upon the final permit shall be applied on payments due or to become due under the final permit.

The minimum rate of ten (10) cents per net electrical horsepower per annum shall also apply upon the date of the termination of the period for the completion of construction and beginning of operation as specified in the stipulation (or in any approved extension thereof), if the works are completed and operation is begun within such specified period and shall increase by ten (10) cents per net electrical horsepower per annum for each year thereafter until a rate of one dollar ($1.00) per net electrical horsepower per annum is reached and shall then remain at that rate until the expiration of the permit.

The minimum rate of ten (10) cents per net electrical horsepower per annum shall apply proportionately to the fractional part of the calendar year succeeding the date of the granting of the preliminary permit, the final permit, and the date specified in the stipulation for the completion of construction and beginning of operation (or any approved extension thereof) if the works are completed and operation is begun within such specified period, and also to the following full calendar year.

If the original permittee sells or transfers his improvements in accordance with Regulation L-15 and a new permit is issued to the vendee or transferee, the subsequent annual charges shall be at the rates that would have been required under the original permit, and any advance payments made by the original permittee may be applied pro tanto on the new permit. If all or any part of the amounts due for charges as required in the preliminary permit shall, after due notice has been given, be in arrears for sixty days, then and thereupon the preliminary permit shall terminate and be void. If all or any part of the amounts due for charges as required in the final permit shall, after due notice has been given, be in arrears for six months, then and thereupon the final permit shall terminate and be void.

Nothing in this regulation shall be construed to alter or amend the rates or the methods of fixing the charges as specifically provided in any existing permit.

Power Capacity of Works.

Reg. L-8. The term "gross power capacity," as used in these regulations, shall mean the power capacity of the entire works to be constructed, maintained, and/or operated in whole or in part, under the permit for which application is made; provided that the term "power capacity," as used in this regulation, shall mean estimated average annual station output in electrical horsepower, which, under continuous operation with reasonable load factor, is possible of development from all water available therefor, falling through effective head, with deductions for reasonable mechanical and electrical losses in generating machinery, and that the term "load factor," as used in this regulation, shall mean ratio of average output to maximum output.

The "net power capacity" upon which the charges are based (see Regulation L-7) shall be determined by making the following deductions from the gross power capacity of the entire works:

(A) An amount bearing approximately the same ratio to the storage power of the reservoir or reservoirs, proposed to be constructed or maintained under permit, as the area of unreserved lands and patented lands within the flood lines of such reservoir or reservoirs bears to the total area within said flood lines, as of the beginning of each year.

(B) An amount bearing approximately the same ratio to the difference between the gross power capacity and the storage power as the length of the conduit or conduits, proposed to be constructed or maintained under permit, upon unreserved lands and patented lands, bears to the total length from intake to power-house of the conduit or conduits, as of the beginning of each year.

(C) From the gross power capacity remaining after deductions (A) and (B) have been made a further deduction shall be made which, in per cent, shall be calculated by multiplying the square of the distance of primary transmission in miles by the constant factor 0.001; but in no case shall deduction (C) exceed twenty-five (25) per cent.

The term "storage power," as used in these regulations, shall mean that part of the aforesaid gross power capacity which is made possible of development by the use of any reservoir or reservoirs to be constructed or maintained in whole or in part under permit. The word "conduit," as used in these regulations, shall include ditches, canals, flumes, pipe lines, and all other means for the conveyance of a flow of water.

If any part of the electric energy generated by the works constructed in whole or in part under permit is used by the permittee in the operation of its own mines, or in the milling or reduction of ores therefrom, or as auxiliary to irrigation works owned and operated by the permittee, or for such other miscellaneous uses as may be determined by the Secretary of Agriculture to fall within "non-commercial" use, the net power capacity upon which the charge for any year is to be calculated shall, before such calculation, be reduced by an amount bearing approximately the same ratio to the net power capacity as the amount of electric energy generated by the works and used for the above purposes, bears to the total amount of energy generated by the works during the last preceding year.

If at any time not less than ten (10) years after the original or after the last preceding determination of the gross power capacity, the permittee or the Secretary of Agriculture on the ground of the inaccuracy, insufficiency, or inapplicability of the data upon which the original or said last preceding determination of the gross power capacity was made, shall apply for or give notice of review of the original or last preceding determination, then and thereupon such review shall be taken by the Secretary of Agriculture and a re-determination of the gross power capacity and of the storage power shall be made, and thereupon the re-determined gross power and the re-determined storage power shall, for the purpose of determining the charges, and from the beginning of the next calendar year, be taken to be the gross power capacity of the works and the storage power of the reservoir or reservoirs.

The decision of the Secretary of Agriculture shall be final as to all matters of fact upon which the determination of the gross power capacity of the works and the storage power of the reservoir or reservoirs depend.

Application for Preliminary Water-Power Permit.

Reg. L-9. All applications for preliminary permits to occupy and use the lands of the United States within National Forests for the purpose of securing the data required for a final application for water-power works and for such construction as may be necessary to preserve water appropriation during the period, shall be filed with the District Forester of the district in which such lands are situated, and shall consist of the following:

(A) An application in triplicate on Form 58, or........

(B) A map on tracing linen and either one Van Dyke negative or three blue print copies, cut to a uniform size not larger than 28 by 40 inches, and not smaller than 24 by 36 inches, with scale so selected as to show the entire project upon a single map, showing the approximate location of the dams, reservoirs, conduits, power houses or other works for which final application is to be made; each separate sheet of maps, estimates and data shall be signed and dated by

the applicant, if the proposed development is to be upon surveyed land, the map shall show for each reservoir site the distance and bearing of one extremity of the dam from the nearest existing corner of the public survey, and the approximate position and area of the flood line of the reservoir; for each conduit line, the distance and bearing of each terminus from the nearest existing corner of the public survey, and the approximate location and length of the conduit; and for each power-house site, the distance and bearing of one corner of the site from the nearest existing corner of the public survey, and the approximate area of the site. If on unsurveyed land, the distances and bearings may be taken from some natural feature that can be readily recognized upon the ground as a stream junction for example, or from a permanent monument, that can be readily found.

(C) A statement in triplicate, estimating the amount of water available for use and the total head at each proposed power house.

(D) Estimates in triplicate of the amount of power that may be developed at each proposed power house.

(E) Prima facie evidence in triplicate, certified by the proper public officer, of the appropriation by the applicant or its predecessors of all the water which it is proposed to use in the operation of the works applied for.

Application must be made for the occupancy and use of such lands for a definite limited period only, which period will allow a reasonable time for the preparation and filing of the final application as prescribed in Regulation L-10.

The time prescribed in the preliminary permit may, upon application, be extended by the Secretary of Agriculture if the completion of the final application has been prevented by unusual climatic conditions that could not reasonably have been foreseen or by some special or peculiar cause beyond the control of the permittee.

Although not required as an essential part of the application, a statement from the District or Supervising Engineer of the U. S. Reclamation Service, to the effect that the granting of the permit applied for will not interfere with any Government reclamation project, should be submitted with the application.

An application for a preliminary water-power permit filed with the District Forester shall not be complete until the last map or paper required by this regulation shall have been filed in the form prescribed.

Application for Final Water-Power Permit.

Reg. L-10. All applications for final permits to occupy and use the lands of the United States within National Forests for commercial water-power works and for non-commercial water-power works of more than 1000 electrical horsepower capacity shall be filed with the District Forester of the District in which the lands are situated, and shall consist of the following:

(a) An application in triplicate on Form —.

(b) Maps of location and plans of structures, both on tracing linen with either one Van Dyke negative or two print copies cut to a uniform size not larger than 28 by 40 inches and not smaller than 24 by 36 inches, with a graphical scale of not less than 6 inches in length drawn thereon. Separate sheets shall be used for maps of location whenever the whole survey cannot be shown upon a single sheet. Each separate sheet of maps and plans shall contain the affidavit of the applicant's engineer and the applicant's certificate.

(1) The following maps and plans shall be filed for each reservoir which will be used as a part of the complete power project: (a) A contour map of each reservoir site, dam, and dam site, on a scale of not more than 400 feet to the inch with a contour interval of not more than 10 feet. U. S Geological Survey datum should be used where available. The maps shall show the reference lines for the initial point of the survey and all land subdivisions within the flood lines of the reservoirs, and the status of all such lands which are within the National Forest, designating separately National Forest land and patented land. (b) Plans, elevations, and cross sections of the dams, showing spillways, sluiceways, or sluice-pipes, the character of the material to be used, and the type of construction.

(2) The following maps and plans shall be filed for the entire length of each conduit which will be used as a part of the complete power project. (a) A contour map of the entire conduit location, except pressure lines, on a scale of not more than 400 feet to the inch with contour interval of not more than 10 feet and a profile of the pressure lines. U. S. Geological Survey datum should be used where available. The contours shall cover either an area of 100 feet in width on each side of the center line of the conduit, or a difference in elevation of at least 25 feet above and below the grade line of the conduit. This map shall show the transit line of the survey and the center line of the proposed final location of conduits, including curves between tangents, the reference line for the location of termini, all land subdivisions to be crossed by the conduit, and the distance, from the nearest section or quarter section corner, of the intersection of the transit line with section lines. If such corners cannot be found within a half mile of the line the fact should be noted upon the map and the tie may be omitted. This map shall also show the status of land within the National Forest which will be crossed by the conduits, designating separately National Forest land and patented land, what sections of the conduit will be in flume, ditch, tunnel, pipe, etc., and the grade of each section. (b) Plans, elevations, and cross sections of each type of conduit, showing material, dimensions, grade, flow line, and capacity, and plans of intake works and forebays.

(3) The following maps shall be filed for all power-house sites which will be used as a part of the complete power project. Contour maps on a scale of not more than 50 feet to the inch with contour interval of not more than 5 feet, of all proposed power-house sites, showing connections between initial point of survey and the reference corner of the public survey, the proposed locations of power-houses, other buildings, etc., and the status of the lands to be used, designating separately National Forest land and patented land. This map shall also state the proposed type and probable number and rated capacity of the water wheels and generators to be used.

(4) The following maps shall be filed for such portions of transmission lines as lie within the exterior boundaries of a National Forest: A map of the survey of the proposed final location of the center line of the transmission line on a scale of not more than 1000 feet to the inch. This map shall show the reference lines for the location of intersections with National Forest boundaries, all land subdivisions to be crossed by the transmission line, the distances from the nearest section or quarter section corner, of the intersection of the survey lines with the section lines and the status of the lands to be crossed by the transmission line, designating separately National Forest land and patented land.

(c) Copies of field notes in triplicate of the entire final location survey of conduits and transmission lines and the exterior boundaries of power-house and reservoir sites, bearing the affidavit of the applicant's engineer and the applicant's certificate.

(d) Detailed estimate in triplicate of the amount of maximum, minimum and average output of the proposed works in electrical horsepower at the generator switchboard, bearing the affidavit of the applicant's engineer and the applicant's certificate. This estimate shall be accompanied by a detailed statement in triplicate of the complete data upon which estimates are based, consisting of a statement of the amount of water appropriated, the estimated average amounts of water to be used from natural flow and from storage, stream measurements, run-off and evaporation records, total

and effective heads, estimated efficiencies of machinery, and estimated load factor of the plant.

(e) Prima facie evidence in triplicate, certified by the proper public officer, of the appropriation by the applicant or its predecessors of all the water which it is proposed to use in the operation of the works. If such evidence has been filed with a preliminary application only such additional evidence will be required as will cover appropriations or transfers subsequent to the date of the evidence filed with the preliminary application.

(f) Articles of incorporation, if a corporation, certified under the State seal, with copies in duplicate, or articles of association or partnership properly certified with copies in duplicate, and, if a corporation organized under the laws of a State or Territory other than the State or Territory in which the project is located, evidence in triplicate, of the right to operate within the State or Territory within which the works are to be located.

Maps and field notes shall designate by termini and length each conduit and transmission line, and by initial point and area each reservoir site, and power-house site. The termini of conduits and intersections of transmission lines with National Forest boundaries and the initial point of survey or power-house and intake sites shall be fixed by reference of course and distance to the nearest existing corner of the public survey. The initial point of the survey of reservoir sites shall be fixed by reference of course and distance to the nearest existing corner outside of the reservoir by a line, or lines, that does not cross an area that will be covered with water when the reservoir is in use. When either terminus or a conduit, or intersections of transmission lines with National Forest boundaries, or the initial point of the survey of a reservoir or power-house site, is upon unsurveyed land, it shall be connected by traverse with an established corner of the public survey, and the distance from the terminus or initial point to the corner shall be computed and noted on the map and in the affidavit of the applicant's engineer. When an established corner of the public survey is more than 2 miles distant, this connection may be with a natural object or a permanent monument which can be readily found and recognized and which will fix and perpetuate the position of the terminus or initial point. This map shall show the position of such point and shall give the course and distance to the terminus and initial point. The field notes shall give an accurate description of the natural object or monument and full data of traverse as required above. The affidavit of the applicant's engineer and the applicant's certificate shall state the connections.

Each separate original map, plan, set of field notes, estimates and data, evidence of water right, articles of incorporation and evidence of right to do business within the State, when required., shall be plainly marked "Exhibit A," Exhibit B," etc., respectively and referred to by such designation in the application. Maps and plans shall in addition be described in the application by their titles as "Exhibit A," map of location of, etc., "Exhibit B," plan of, etc. Duplicate and triplicate copies should be marked "Exhibit A, Duplicate," "Exhibit A, Triplicate," etc. Maps should be rolled for mailing and should not be folded.

An application for final permit filed with the District Forester shall not be complete until the last map or paper required by this regulation shall have been filed in the form prescribed.

Application for Non-Commercial Water-Power Permit, 1000 Horsepower or Less.

Reg. L-11. Applications for permission to occupy and use the lands of the United States within National Forests for non-commercial water-power works of 1000 electrical horsepower capacity or less, shall be filed with the District Forester of the District in which such lands are situated, shall be in writing, and shall be accompanied by:

(a) A map in triplicate showing the location of dams, reservoirs, conduits, power-houses and transmission lines or other works.

(b) Field notes of the survey in triplicate.

(c) Prima facie evidence in triplicate, certified by the proper public officer, of the appropriation by the applicant or its predecessors of all the water which it is proposed to use in the operation of the works.

(d) A statement in triplicate of the amount of water to be diverted for use and the amount of power to be developed.

The map shall consist of one original on tracing linen and either one Van Dyke negative or two print copies, and shall be not larger than 28 by 40 inches or smaller than 24 by 36 inches, and may be of any convenient scale. If the proposed development is to be upon unsurveyed land, the map shall show, for each reservoir site, the distance and bearing of the initial point of survey from the nearest existing corner of the public survey, the location of the flood lines of the reservoir, and its area; for each conduit line, the distance and bearing of each terminus from the nearest corner of the public survey, the location of the center line of the conduit, and its length; and for each power-house site, the distance and bearing of the initial point of survey from the nearest corner of the public survey, the location of the exterior boundaries of the site and the area. If on unsurveyed land the distances and bearings may, if the nearest existing corner of the public survey is more than two miles distant, be taken from some natural object or permanent monument that can be readily found and recognized, and which will fix and perpetuate the position of the terminus or initial point.

Reg. L-12. Before a water-power permit for non-commercial water-power works of over 1000 electrical horsepower capacity shall be issued, the permittee shall execute a stipulation to include such of the requirements enumerated in Regulation L-13 as may be necessary to protect National Forest interests. Stipulations will not be required for non-commercial water-power works of 1000 electrical horsepower or less, or for transmission lines, not a part of any water-power works covered by a water-power permit.

Stipulations by Applicant for Final Water-Power Permit.

Reg. L-13. Before a final permit for commercial water-power works shall be issued, the permittee shall execute and file with the District Forester a stipulation:

(A) To pay for the full value of all merchantable timber upon National Forest lands to be cut, injured, or destroyed.

(B) To pay full value for all damage to the National Forests resulting from the breaking of or the overflowing, leaking or seeping of water from the works to be constructed, maintained or operated under the permission applied for and for all other damage to the National Forests caused by the neglect of the permittee or the employees, contractors, or employees of the contractors of the permittee.

(C) To dispose of all brush and other refuse resulting from the clearing out or cutting of timber on the National Forest lands to be ocupied under the permit for which application is made.

(D) To clear and keep clear the land along the transmission line where it crosses National Forest lands.

(E) To protect all Government and other telephone lines at crossings of and at all places of proximity to the transmission line and to maintain the line in such a manner as to prevent injury to stock grazing on the National Forests.

(F) To do all reasonably within its power to prevent and suppress forest fires on or near the lands to be occupied under permit.

(G) To build and repair roads and trails whenever any roads or trails are destroyed or injured by construction work or flooding under the permission applied for, and to build and maintain necessary and suitable crossings for all roads and trails which intersect the conduit, if any, constructed, op-

erated or maintained on the lands the occupancy and use of which is applied for.

(H) To sell electric energy to the United States, when requested, at as low a rate as is given to any other purchaser for a like use at the same time; provided that the permittee can furnish the same to the United States without diminishing the measured quantity of energy sold before such request to any other customer by a binding contract of sale; and provided further, that nothing in this clause shall be construed to require the permittee to increase its permanent work or to install additional generating machinery.

(I) To construct its works on the locations shown upon and in accordance with the maps and plans filed with its final application for a water-power permit and to make no material deviation from said location unless and until maps and plans showing such deviation shall have been filed with the District Forester and approved by the Secretary of Agriculture. (See Regulation L-15).

(J) To begin the construction of the works, or the several parts of the works, within a specified period or periods from the date of the permit for which application has been made, and thereafter to diligently and continuously prosecute such construction unless temporarily interrupted by climatic conditions or by some special or peculiar cause beyond the control of the permittee. The term "construction of the works" as used in this regulation shall be deemed and taken to mean only the actual construction of dams, conduits, power houses, transmission lines, or some permanent structure necessary to the operation of the completed works, and shall not include surveys or the building of roads and trails, or the clearing of reservoir sites or other lands to be occupied, or the performance of any work preliminary to the actual constuction of the permanent works.

(K) To complete the construction and begin the operation of the works, or the several parts of the works, within a specified period or periods from the date of the permit for which application has been made.

(L) That any approval by the Secretary of Agriculture of any alteration or amendment, or of any map or plan, or of any extension of time, shall affect only the portions specifically covered by such approval: And no approval of any such alteration, amendment, or extension shall operate to alter or amend, or in any way whatsoever be a waiver of any other part, condition, or provision of the stipulation.

(M) To pay annually in advance for the use and occupancy of the land at the rate specified in Regulations L-7 and L-8.

(N) To operate continuously for the generation of electric energy the works constructed and maintained in whole or in part under the permit unless upon a full and satisfactory showing that such operation is prevented by unavoidable accidents or contingencies, this requirement shall be temporarily waived by the written consent of the Secretary of Agriculture.

(O) That the works to be constructed and maintained under the permit, will not be owned, leased, trusteed, possessed, or controlled by any device or in any manner so that they form part of, or in any way affect any combination in the form of an unlawful trust, or form the subject of any contract or conspiracy to limit the output of electric energy, or in restraint of trade with foreign nations or between two or more States or Territories, or within any one State or Territory in the generation, sale, or distribution of electrical energy.

(P) To install and maintain in good operating condition accurate measuring weirs, gauges, and other devices approved by the Secretary of Agriculture, adequate for the determination of the natural flow of the stream or streams from which the water is to be diverted for the operation of the works and of the amount of water used from the natural flow in the operation of the works and of the amounts of water held in and drawn from storage, and to keep accurate and sufficient records, to the satisfaction of the Secretary of Agriculture, of the above named measurements.

(Q) That the books and records of the permittee in so far as they show the amount of electric energy generated by the works constructed or maintained, in whole or in part, under permit, or the amount of water held in or used from storage, or the stream flow or other data of the watershed furnishing water used in the generation of electric energy, shall be open at all times to the inspection and examination of the Secretary of Agriculture, or his duly authorized representative, and that the permittee will during January of each year make a return to the Secretary of Agriculture, under oath, or such of the measurements or records made by or in the possession of the permittee as may be required by the Secretary of Agriculture and for the year ending on December thirty-first preceding.

Changes in Location or Structures During Construction.

Reg. L-14. During the progress of construction amendments to maps of location or plans of structures will be required from the Permittee if there is a material deviation from the maps or plans as originally filed, but no deviation will be considered material which involves a change of less than 10 per cent in the estimated gross capacity of the works, or a physical interference with the use of lands granted by existing permits or pending applications. Any approval of an amendment of a map or plan, or of any extension of time shall be in the form of a supplemental stipulation and permit so drawn as to become a part of the original stipulation and permit, and a substitute for the clauses amended. Any approval by the Secretary of Agriculture of any amendment of any map or plan shall apply only to the portions specifically covered by such approval and no approval of any such amendment shall operate to amend or be in any way a waiver of any other part, condition or provision of the stipulation.

If after the completion of the works there are any deviations in locations from those shown upon the original map, or approved amendments thereof. additional maps prepared in the manner prescribed for original maps of location will be required to be filed with the District Forester within six months after the completion of each part of the works showing the extent of such deviations and the final locations of such parts of the works. Also upon the completion of the works detailed working plans will be required of the works as constructed, except of such parts as have been constructed in compliance with plans originally filed or approved amendments thereof. Such new or additional plans may be originals on tracing linen or Van Dyke negatives of the Permittee's own working plans. The plans of conduits, dams, and appurtenant structures must be complete; of power houses, only general lay-out plans are required.

Extension of Time for Beginning and Completion of Construction.

Reg. L-15. An extension of the periods stipulated by the Permittee for beginning construction, or for the completion of construction, and the beginning of operation, will be granted only by the written approval of the Secretary of Agriculture after a showing by the Permittee satisfactory to the Secretary of Agriculture that the beginning or completion of construction and beginning of operation has been prevented by engineering difficulties that could not reasonably have been foreseen, or by other special and peculiar causes beyond the control of the Permittee.

Transfer of Water-Power Works and Issue of New Permit.

Reg. L-16. Upon the presentation to the Secretary of Agriculture of certified copies of Sale, Lease, Assignment, Execution of Judgment, or other form of transfer of the properties or other rights of the Permittee in and to the works

constructed under a water-power permit and of the water or other rights necessary to the enjoyment of the use of the said works, the said Secretary may, in his discretion, upon the formal surrender of the original permit, and the filing of a stipulation satisfactory to the said Secretary by the purchasers, transferees, executors, successors, lessees, or assigns of the original permittee, issue a new permit for the unexpired term of the original permit to such purchasers, transferees, executors, successors, lessees or assigns, authorizing him, it or them to occupy and use the lands of the United States specified in the original permit for the purposes named in the original permit.

False Certificates and Affidavits by Applicants and Engineers.

Reg. L-17. If any person shall make a false engineer's affidavit under regulation L-10. The Secretary of Agriculture may order that no map, field notes, plan, or estimate made by such person shall be received or filed while the order is in force. If any applicant shall offer or file any map, field notes, plan, or estimate bearing a false engineer's affidavit, knowing the same to be false, the Secretary of Agriculture may order that no water-power application shall be received from, and no water-power permit shall be granted to such applicant while the order is in force.

MACHINE TOOL-DRIVE.

BY PAUL R. SHIPLEY.[1]

The direct current motor of 220 volts has proven the most satisfactory installation where a wide range of speed is required for machine tool-drive for lathes, for boring mills of the vertical and the horizontal type, for drill-presses, shapers, and so forth. But for planers, slotters, punch and shears, rolls, fans, centrifugal pumps, line shafting, and similar apparatus the alternating current motor of 220 or 440 volts has been found the most efficient.

The alternating current motor, when used in planing mills or where dust is present, has the field to itself, as it causes no commutator troubles. Dust and other foreign matter have proven destructive to the direct current machine. Where a direct current motor of the shunt and compound-wound type is used much care must be taken to protect the shunt field circuits, because an open in such circuits will always prove disastrous to the motor as well as to the tool. This is so because an excess of speed is attained when the shunt field circuit is opened.

Direct-connected shunt and compound-wound motors of the variable speed type are the most valuable for machine drive, and such motors should be used for metals, castings, and forgings. In the old methods of cone drive considerable loss of time was caused by the shifting of belts, the changing of gearing.

The most desirable and perfect motor for lathes, boring mills, drill presses, bolt cutters, and so on is the shunt-wound type with an interpole. The windings on such a motor are in series with the armature and are sparkless under every condition, and they have the rocker arm stationary. With this motor the widest ranges of speed are obtainable, and perfect commutation is secured. These motors are of the same horsepower rating as the common type of shunt and compound-wound, but they are considerably larger on account of the low speed attainable and also on account of the small interpole and the additional size of the armature. This feature has too often been the cause of the use of the common type of shunt and compound-wound motors. Since space is invariably a feature of machine tool design, shapers should be driven by compound motors of variable speed types, as the reversal of the cutting tool increases the torque. The compound winding assists materially in handling the inrush of current within reasonable limits. And that is a material consideration.

Compound-wound motors should be used on all machines of the reciprocating type, such as planers, slotters, shapers, and so on. But I have found that motors of the interpole type gave very good satisfaction on slotters, and that the common shunt-wound type proved itself fairly well on planers.

The main feature of the reciprocating drive is the self-regulation of the motor. It is most noticeable in the shunt and compound-wound type, or in the induction motor, as the speed varies slightly in these motors, from no load to full load. With motors for planers allowance should be figured for the short travel of the planer bed on short cuts, as considerable current is required for the reversal. The horsepower required for this type of machine should be determined only on the inrush of current on quick reversals, rather than on the power the cutting tool requires. Heavy fly-wheels will, to a certain extent, remedy this evil when used on punch and shears, presses, and other machines requiring fly-wheel acceleration; but great care should be observed in starting because of the heavy inrush of current during the period of acceleration.

Motors of 1500 or more revolutions a minute, of the direct current type, will always cause commutation troubles if direct-connected to fans, blowers, and so forth, as the high speed causes considerable vibration. But this trouble can be partly eliminated by the use of belts.

Series motors are mostly used only for cranes, hoists, transverse and turntables; the speed, of course, varying with the loads. They will stand an almost unlimited amount of hard usage. But the series motors or any motor requiring the use of armature resistence for regulating duty proved by actual use to be disastrous to machine tool-drive.

All starting and regulating apparatus for machine tool-drive should be located or controlled from a point very handy to the operator, and, when possible, should be located on the carriage of the machine.

Any silent chain drive simplifies a machine, as it entirely eliminates the network of gears. It is also valuable where the driving gear is located some distance away, but this would require intermediate or idler gears and additional shafting and bearings.

Rawhide gearing is an important factor in machine tool-drive; it eliminates noise. But my advice is to get your rawhide gearing much larger than the steel-cut or brass gears for the same work.

The cost of maintaining an alternating current motor of the induction type is small as compared with the cost of maintaining a commuting motor. So the alternating current drive is far better adapted for planing mills, private machine shops, laundries, and such industrial concerns.

[1] Sacramento Division, Pacific Gas & Electric Co.

THE HISTORY OF GAS-LIGHTING IN VALLEJO.

BY E. C. JONES.[1]


E. C. Jones

Vallejo was created in the belief that it was to be the capital of California. In early days Santa Barbara and then Monterey had been old Spanish and Mexican capitals. California's first legislature had met at old Monterey in the winter of 1850, and later, upon urgent solicitation and the extension of many glowing promises, had moved the seat of government to the more convenient town of San Jose, which proved too small to house the few score legislators that came in by stages and wagons in the rainy season.

Then came the princely offer of General M. G Vallejo. He would give the state a site for a capital, and he would erect upon it a state house. For did he not possess an immense Mexican grant of 250,000 acres of land, including most of what is now Solano County and all of Mare Island, the reserve pasture where he kept his mares. In early days in California mares were always pastured, never worked. San Jose increased her bid; she would deed a park area of several city blocks. Ah! but General Vallejo would give the state a townsite up at the head of San Francisco bay, accessible both by land and by water and on the regular route between San Francisco and the mines and nearer to the centre of population in that pioneer period, when the tributaries of the Sacramento held their tens of thousands of gold-seekers.

So, in January of 1852, the legislators converged upon the new state capital at Vallejo. They came by river steamers, in the rain, and they found only a long, wooden, barn-like building standing dismally at the edge of the tules that skirted the narrow strait, across which the city of Vallejo, with some 15,000 people, now looks boldly and unafraid at the warlike equipment of the Mare Island Navy Yard. Those early legislators shivered, they sneered, and perhaps some of them swore, for the town to be was not there yet. The wooden state house was about the only shelter in sight. Financial difficulties had come to General Vallejo, and he had not been able to fulfill his expectations. So the next year near-by Benicia became the capital, and had San Jose and Sacramento as hopeful rivals until Sacramento the next year won out with better promises. Again the fates had been unkind to the Vallejos.

Here it is of interest to introduce a bit of little-known California history as related in San Francisco a few years ago by Mrs. F. A. Van Winkle of Colusa, who as Miss Frances Anne Cooper of Howard County, Missouri, arrived in California with her father's family in 1846, and the 3d of October of that pre-pioneer year settled with the family at what is now Napa. Here is her story in part:

"Father had moved to San Francisco, now called Benicia, and had started a boarding house. Dr. Semple, who was a native of Kentucky, owned nearly all the land where the town is now. In those days that was thought to be the coming city. The present San Francisco was but an insignificant group of tents occupied by Spanish people and bearing the name Yerba Buena. Governor Vallejo had made Dr. Semple a present of half of Benicia, believing that he would build it up

"I was married in Benicia in the fall of 1847. The ceremony was performed [by ex-Governor Boggs of Missouri] in the big dining-room of my father's boarding house.

"My husband, Dr. Semple, owned the only ferry-boat at Benicia. It was often said that he made enough money with it to sink that boat a half dozen times over, but he was one of the most remarkable speculators I ever knew, and went right through his money.

"Our town was San Francisco, but the people down here took the name away from us. Dr. Semple opposed them, but it did no good. They named this place San Francisco and dropped the name Yerba Buena. So Dr. Semple called his town Benicia, after Mrs. Vallejo, whose maiden name was Francisca Benicia. We lived in Benicia just four years, then moved to what is now Colusa. My [first] husband [Dr. Semple] owned half of Colusa, old Colonel Hager owning the other half."

To be a State capital is not always the best thing for a town; not always its only excuse for existence. Vallejo grew any way, and by 1866 it had become such a good-sized community that then M. P. Young, who had been connected with the San Francisco Gas Company, went up to Vallejo and started a gas works. It was a good deal on the style of the Vallejo State house; short on architecture and stability, but long on fresh air. In fact, it had no roof, no building. The apparatus was out in the open, and there was a 7000-foot holder floating in a redwood tank that leaked so copiously that the fireman had to spend part of his time pumping water back into it, according to the story as briefly related by T. R. Parker, whose article on "Auld Lang Syne" before the twelfth annual meeting of the Pacific Coast Gas Association in 1904 has been freely borrowed from for this sketch.

Very properly Vallejo celebrated the 4th of July in 1866 by having her first gas-lighting that night. They needed gas lights in Vallejo in winter. It was a mucky job for pedestrians groping about through deep, mushy, sticky adobe mud. Other California towns during the preceding twelve years had started using gas at the rate of about $10 a thousand, but Vallejo began modestly at $7.50. And what happened to the man who began the business on that basis? He discovered John Lee, a hotel proprietor, side-tracking the gas meter and stealing a supply direct, and the discovery cost Young his life, for Lee's vengeful bullet proved fatal a month after the shooting, which occurred the 21st of August, 1867.

In 1867 H. M. Snow, one of the progressive business men of Vallejo in those days, started a new gas company and secured the co-operation of John W. Pearson of San Francisco and General John B. Frisbie, for whom the Vallejo passenger steamer General Frisbie is named. Their company erected a new gas works at the foot of Maine street. The plant consisted of three benches of 3's and a 20,000-foot holder. The producing capacity was about 30,000 cubic feet of gas a day. Peter F. Fagan was this company's first superintendent, and W. J. Tobin its first secretary. About $8000 was expended upon the plant, and pipes were laid in Santa Clara, Georgia, Sacramento, and Marin streets, and twelve street lights were furnished the town free of charge. But the receipts from consumers were only about enough to pay the running

[1] Chief Engineer Pacific Gas & Electric Company's Gas Department.

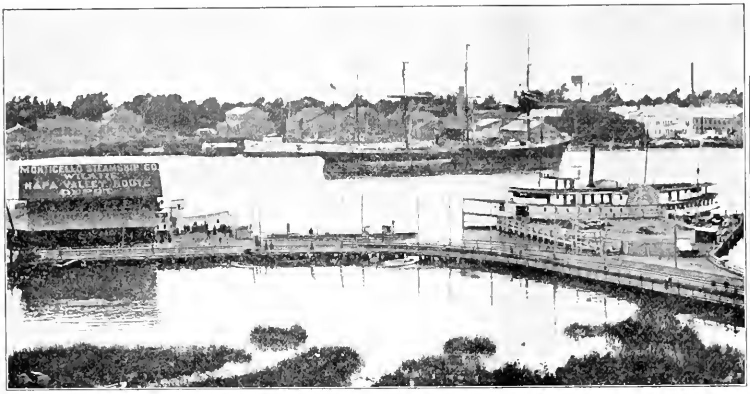
expenses. After a year's operation Frisbie and Snow bought out Pearson. And the next year Snow became convinced that the business was not a paying investment, so he sold out his interest to Frisbie, who thus became sole owner.

John B. Frisbie came across the plains to California in 1849 as a captain in Stephenson's regiment, and when the Society of California Pioneers was formed in 1850, Frisbie was number 80 on the roll of its 500 charter members, among the 100,000 people that had rushed into California in 1849 and the 420 other Americans who had been earlier straggling in, from the first one who arrived in 1801 to the sixty-five who came in 1848.

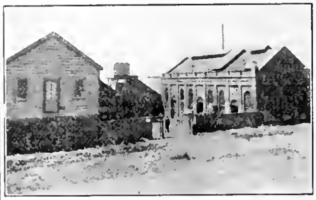
make gas then, and Vallejo was being supplied at the comparatively low price of $6 a thousand.

It was not until 1871 that the transactions of the company began to appear of record on the minute book. The earliest entry shows that General John B. Frisbie was president, and that the capital stock was then $40,000. November 10th of that year the capital was increased to $250,000, and $75,000 of it was issued.

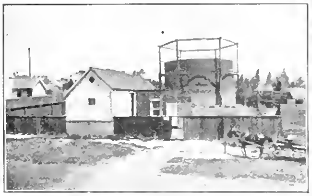
In 1876 a two-inch gaspipe was laid across the bottom of the channel to Mare Island to supply gas to that place. The laying of this pipe was accomplished by J. R. Smedberg, an engineer identified with the San



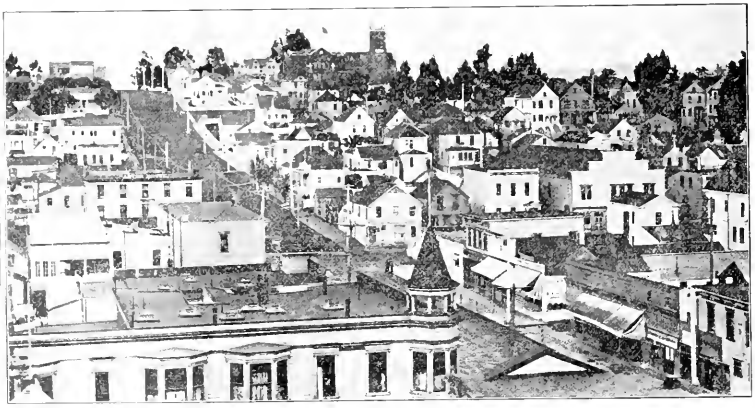
A Bit of Vallejo's Waterfront, Looking Across to the Mare Island Navy Yard.



The Old Coal-Gas Works at Vallejo: on the left the Purifying House, on the right the Retort House.



The office, the Meter room, and the Gas Holder to which a Second Lift was added while in use.



A Residence Section of Vallejo, as Viewed from the Waterfront.

In 1870 the gas works was moved to its present location, down at the waterfront on Maryland street, between Marin and Sonoma streets, and there a new works was erected with a capacity that could, it was thought, be enlarged to supply a city of 25,000 people. There were two benches of three retorts each and these retorts were each nine feet long. At that time the service, through a system of 20,000 feet of pipe, supplied 200 consumers, about 800 gas burners, and fourteen street lights. It cost about $4.04 a thousand to

Francisco company. The advance end of the pipe was buoyed up by two empty barrels to keep the pipe from running foul of obstructions on the bottom or becoming clogged with mud. After the connection was completed an Otto gas engine and exhauster were used to force the gas through the pipe. A small holder was built on the Mare Island side from which to supply the consumers rather than subject them to the direct pulsating pressure of the pump.

November 10th, 1877, J. K. Duncan, who had been

one of the early stockholders, was elected president of the company.

The 2d of June of 1882 E. J. Wilson, a prominent citizen of Vallejo, became president.

It was not until June 7th of 1883 that the business had become sufficiently profitable to warrant a dividend, and then the first one was declared, sixteen years after the founding of the company.

June 16th, 1886, the works was leased for a year to Alexander Badlam, who had been a well-known early San Franciscan, and it appears of record that June 3d of the following year the vote was to let the Badlam lease go on from month to month; but there is no entry as to just when it terminated.

At the annual meeting, June 7th, 1889, they were considering the advisability of going into the electric lighting business, but it does not appear that they got any further than considering. At that meeting G. W. Wilson, now a bank president of Vallejo, was elected secretary.

At the annual meeting in June of 1895 S. C. Hilborn was made president.

In October of 1896 a unique and hitherto unattempted gas engineering feat was accomplished, when a second lift was added to the original 20,000-foot gas holder while the holder was still in use.* The old single-lift holder was changed to a telescopic two-lift holder. A new holder would have cost between $5000 and $7000, and would have required new ground, or the removal of the old holder, but a double capacity was given the old holder at a cost of only $1700. The old holder was forty feet in diameter, sixteen feet high, and was suspended inside six redwood columns twelve inches thick and braced with wooden girders. As it was the only holder in the city at that time it was necessary to keep it in use during the change. The wooden columns were extended in height, and a staging was constructed so that the new holder could be built. The difficult part of the problem was to build a cup under the old holder without interrupting its regular use. The bottom rollers were taken off, wooden rollers eight inches in diameter were fastened to the columns about two feet and a half above the top of the wall, and some two-inch by four-inch pieces of wood were fastened vertically against the side of the holder for the rollers to run on. Thus the holder was kept from tilting. The bottom cup was made in six sections of four-inch channel iron, the outside sheet eighteen inches wide, the inside sheet twenty-four inches wide. Five sections of the cup were riveted and bolted together around the old holder before they were connected; the cup was then suspended to the holder by chains, and a turnbuckle was put on, and the cup drawn tightly around the holder, leaving only a section of about three feet to be put in after the five sections had been bolted to the old holder. The holes had been punched in the cup sheet, but those in the old holder were drilled, and, as rapidly as drilled, were temporarily plugged with wood. The bolting of the cup up around the old holder required the creation of an ingenious little contrivance designed for the purpose. It consisted of a U-shaped section of gaspipe, one end of which was slotted to hold the head of the bolt and leave the threaded end projecting toward the other arm of the U. Then the end holding the bolt was introduced under the holder, the U righted to the perpendicular, so that a pointer fastened in the outside arm of the U exactly opposite the slot on the inside arm, when advanced till it touched a wooden plug and then drawn directly back, would bring the screw end of the bolt exactly against the inside of the hole and a further backward pull on the U would bring the screw on through. The projecting end of the screw was then gripped, and the U device withdrawn from the head of the bolt, and the nut screwed on the outside. From bolt to bolt this process was continued. This whole plan of enlarging the holder capacity of a small gas works became a model for other comparatively small works that desired to increase their capacity without interfering with the workings of their plant. The mechanical construction of this work at Vallejo was carried through by the late L. F. Fogg.

June 6th of 1902 F. W. Hall became the president, and October 14th, 1904, S. J. McKnight was chosen to head the company, and November 11th the old minute-book records the last meeting of the old company's trustees.

December 18th, 1905, the Vallejo company passed to the ownership of the California Gas & Electric Corporation, and twelve days later a deed conveyed it to the Pacific Gas & Electric Company.

Up to the time of the transfer of ownership to the California Corporation Vallejo's gas had been made from coal. But immediately after the works passed to the new owners a thoroughly modern equipment was substituted to manufacture gas from fuel-oil.

For the nineteen years from 1886 to 1905 John W. Thomas was superintendent of the Vallejo Gas Company, and served it faithfully, and ever since the transfer in ownership he has continued to be a reliable figure identified with the gas business at Vallejo.

As it stands today the works occupies both sides of Maryland street. The old purifying house, the retort house, and a fuel-oil tank are on the water side of the street, and have a small L-shape pier extending into the channel, where oil barges come up and discharge the fuel-oil that is now used in the manufacture of Vallejo's gas. Across the street is the original 20,000-foot holder, with its additional lift that makes its total capacity 40,000 cubic feet, and near by is a relief holder for 20,000 cubic feet.

*Editorial Note:—The plan of this bit of engineering was conceived by E. C. Jones, though he modestly omits his connection with it.

STATE BOARD OF POWER CONTROL.

A bill has been introduced in the California Legislature providing for a State Board of Control which is to grant permits for the use of water powers not already appropriated.

The bill provides that the State board's electric and power permits shall not be for a longer period than twenty-five years. One section abrogates all appropriations of water which have not been put out or which are no longer put to some beneficial use. All appropriations are to be subject to the right of the State to fix rates for which electricity and power shall be sold or distributed

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Waterpower Regulations

In the new water-power regulations just signed by the Secretary of Agriculture the same old suit of clothes has again come back from the tailor; certain alterations have been made, the rents reduced and the methods mended, but it is still the same unsatisfactory garment. Patched permits and tinkered tariffs are much alike, for ultimately they must both be made over. The amended regulations are better than those they displace, but are yet inadequate to properly cover this important matter.

The department concedes the disputed point that water rights are beyond its jurisdiction, its annual rental being based upon the net power capacity of the government land occupied. The regulations contain many precautions intended to prevent speculative holdings, but there still remains a most difficult piece of necromacy to separate the sheep from the goats by differentiating the good or bad faith on the part of the promoters.

Hydroelectric financiers recognize the equity of this basis of calculation, but find the annual rate of one dollar per horsepower capacity to be excessive, though it is about one-third less than the previous charge. Many large blocks of power are now bought and sold in the Western states on the basis of from twenty to twenty-five dollars per horsepower year and cases can be cited where power is sold at one-half this price. It is thus seen that the government is exacting an annual rental of from four to five per cent. of the power value of the land it owns, whereas private holders of similar land are willing to lease for indefinite and irrevocable periods at one-half this price.

The government not only demands a higher rental but offers less certain tenure, as the fifty-year permit is always revocable at the predilection of the Secretary of Agriculture. Men will not invest money unless they are assured reasonable protection; this the government does not offer, and so discourages legitimate power development.

The requirements as to surveys and maps are so unreasonable that their absurdity would be laughable if their rigor did not prevent any but the richest corporations from complying. There is many a little hydroelectric project capable of profitable development which cannot afford the expense of maintaining a small army of engineers for nearly a year to get the required data.

Reading between the lines of these regulations, it would appear that there is not an honest engineer, power-plant manager or water-power banker west of the Missouri River, otherwise why should their advice be so grossly disregarded in these rulings which throttle legitimate development? It is all very well to prate about protecting the people's landed holdings, but it is another matter to deliberately retard the natural growth which accrues from cheap and abundant power. The new regulations are a step in the right direction and show that the Forest Service is willing to meet this question half way if the restrictions of the Act of 1901 are removed by Congress. Till then it is powerless.

PERSONALS.

E. S. Tice has been appointed manager of the Twin City Light & Traction Company, of Chehalis, Washington.

O. C. Merrill, chief engineer of the U. S. Forest Service, whose office is located at San Francisco, is at Washington, D. C.

Fred L. Webster, manager of the Independent Telephone Company of Seattle, Wash., arrived at San Francisco during the past week.

C. F. Conn, of the engineering staff of J. G. White & Co., returned to San Francisco last week, after spending a month at the New York office.

H. B. Bradford, who has electric power interests in Nevada, arrived at San Francisco last week and attended the international aviation meet.

A. G. Wishon, general manager of the San Joaquin Light & Power Company, arrived at San Francisco last Monday and conferred with his engineers.

Paul Shoup, vice-president of the Pacific Electric Railway Company, recently returned to his Los Angeles office, after spending several days at San Francisco.

Horace R. Hudson, treasurer of the Humboldt Transit Company, Eureka, Cal., has also been elected secretary of the company to succeed Mr. Burke Corbet.

Delos A. Chappell, of the Hydroelectric Company, arrived at San Francisco from Bodie during the past week and spent several days at the local office of the company.

Clifford S. Maccalla has been appointed general manager of the Washington Water Power Company of Spokane, Wash., succeeding D. L. Huntington, who retains his position as president.

S. Guthrie, secretary and treasurer of the Kellogg Switchboard and Supply Company of Chicago, has gone to Los Angeles after visiting H. C. Goldrick, Pacific Coast manager at the San Francisco office.

Milton D. Grosh, a consulting electrical engineer, of Salt Lake City, is a San Francisco visitor. He was formerly the General Electric Company's Utah representative and resigned to take up consulting work.

W. B. Lewis, who was for some time connected with the office force of the Western Electric Company's San Francisco branch, has joined their corps of traveling men and is now making a trip through Oregon.

J. J. Hooper has been appointed superintendent of the Stockton Electric Railroad, of Stockton, Cal., succeeding Frank W. Webster who is acting as general manager and purchasing agent of the company.

Patrick Calhoun, president of the United Railroads of San Francisco, left last week for a short Eastern trip, accompanied by Thornwell Mullally, his assistant. It is understood that they will do some "boosting" for the Panama-Pacific International Exposition of 1915 during their absence.

E. J. Kendall has resigned as general superintendent of the Snow Mountain Water & Power Company's hydroelectric plant near Ukiah, Cal., his duties being assumed by W. S. Graham, general manager of the company. Mr. Kendall has been general superintendent during the several years of the company's construction period.

E. G. Williams, general manager of J. G. White & Co. of New York, arrived at the firm's San Francisco office last Wednesday on an inspection tour of the Coast. He has already looked over the work which they have in hand in Southern California, including the San Joaquin Light and Power Company's new steam and hydroelectric installations and the Pacific Light and Power Company's steam plant at Redondo.

C. B. Zabriskie, the New York representative of F. M. Smith, the principal owner of the Oakland Traction and Key Route system, and one of the directors of the new United Properties Company, arrived at Oakland during the past week. He has been conferring with his principal preparatory to filing articles of incorporation of the $200,000,000 merger at Sacramento. F. M. Smith will be president of the United Properties Company; W. S. Tevis, first vice-president, and R. G. Hanford, second vice-president.

MEETING NOTICES.

The meeting of the International Independent Telephone Association at Chicago has been postponed until February 8, 9, 10, 1911.

A meeting of the Portland Section American Institute of Electrical Engineers will be held at the Electric Building, on January 17, when E. J. Griffith will speak on Conservation.

The next meeting of the Los Angeles Section of American Institute of Electrical Engineers will be held at Blanchard Hall on Tuesday, January 24th, 1911, at 8:00 p. m. At that time Professor Ryan will present his paper on the "Corona." This is expected to be one of the most interesting meetings of the year, and visiting engineers are cordially invited to be present.

TRADE NOTES.

The Payette Heights Irrigation Company have installed a pumping plant to irrigate 4000 acres near Payette Idaho. The installation consists of two 75 h.p. Fairbanks-Morse motors driving Byron Jackson pumps.

The Westinghouse Electric & Manufacturing Company has just received an order for one 100 k.v.a. three-phase, 60 cycle, 480 volt, 900 r.p.m. belted type generator, a two-panel switchboard and several induction motors to be shipped to the Mina Mexico Company, Tonichi, Sonora, Mexico.

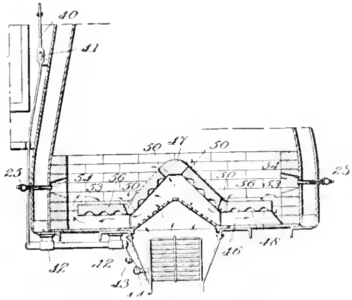
Chas. C. Moore & Co., have received the contract for designing and erecting a 300 kw. plant, including turbo-generators, B. & W. boilers, Platt heaters, and Wheeler condensers for the Vancouver Portland Cement Company. They have also been awarded a contract to complete 3000 kw. power plant for the Mt. Hood Railway at Portland.

Kilbourne & Clark Mfg. Co. of Seattle, Wash., one of the oldest established and largest electrical machinery and engineering firms on the Pacific Coast has disposed of its business to George B. Adair & Son Company. Frederick B. Simpson is retained as secretary and chief engineer.

The Kellogg Switchboard and Supply Company has just closed a contract with the Northern Electric Railway Company of California for a complete telephone equipment for the main line between Sacramento and Chico, together with branch lines. The installation will consist of what is known as a "commercial circuit," equipped with fifty 5-bar bridging telephones, which will be used for all commercial intercommunicating on the system, and a "despatching circuit," consisting of a chief despatcher's equipment at Chico, with twenty high-speed Gill selectors, together with necessary telephone equipment located at the various way stations along the line. This latter circuit will be used for issuing train orders and receiving reports from train crews only. During the day, while traffic is heaviest, the despatcher remains on the circuit all the time with the head telephone set. In receiving reports from various train crews the only necessary operation is for the conductor to come in on the line and give a report without signaling. During the slack period, and at night, a bridging bell is cut across the line at the despatcher's office, and when any report is to be given the conductor signals the despatcher by turning a powerful 5-bar hand-generator, which will ring a bell at the despatcher's office. The equipment on the despatching circuit is the standard railway despatching equipment, such as the Kellogg Company has installed for a great many railroads all over the country, including the Southern Pacific in California.

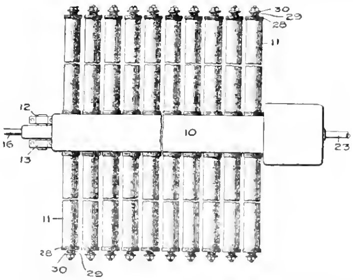
PATENTS

980,806. Oil-Fed Furnace. Arthur H. Light, Los Angeles, Cal. In an oil fed furnace, the combination of an oil supply pipe; a steam supply pipe; a superheater through which the steam passes; an atomizing chamber connected to said superheater and with said oil supply pipe in which said oil and steam are finely divided; a plurality of burner tips delivering into



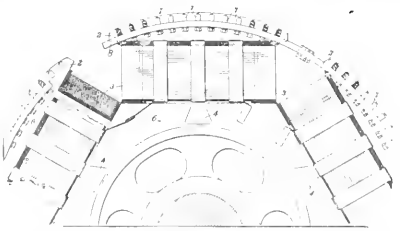
the furnace; connections between said chamber and said tips; and means to supply air to said furnace comprising a plurality of passages located at varying distances from said tips, the passage nearest said tips being larger than those away from the same; substantially as described.

980,505. Apparatus for Utilizing Solar Heat. William L. R. Emmet, Schenectady, N. Y., assignor to General Electric Company. In an apparatus of the character described, the combination of a fluid-containing vessel that is heated exter-



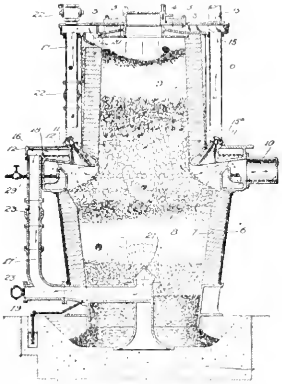
nally by the rays of the sun, with a jacket therefor that has a vacuum chamber with a transparent portion through which said rays pass and act on the vessel.

980,183. Synchronous Dynamo-Electric Machine. Jens Bache-Wiig, Edgewood Park, Pa., assignor to Westinghouse



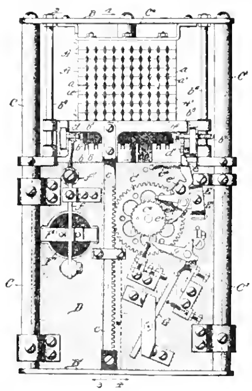
Electric & Manufacturing Co. A synchronous dynamo-electric machine comprising polar projections having transverse peripheral slots, and conducting bars located in the slots and constituting parts of a closed-circuit winding, the bars near the edges of the polar projections being of lower resistance than those near the centers thereof.

980,660. Gas-Producer. Charles F. Miller, Pittsburg, Pa., assignor to The Westinghouse Machine Company. A producer comprising an up-draft section, a down-draft section with its outside diameter less than the greatest interior diameter of



the up-draft section, a vaporizing top located between said sections with a gas offtake port and a plurality of poke holes so disposed as to permit passing a slice bar along the inner walls of the up-draft section.

980,417. Automatic-Exchange Selector. Howard B. Holmes, Park Ridge, and Edward B. Craft, Chicago, Ill., assignors to Western Electric Company, Chicago, Ill. A selector switch comprising a bank of fixed contacts arranged in parallel rows, a group of brushes corresponding respectively to the different rows of fixed contacts and electrically connected in multiple,



a movable support common to said brushes, means for selectively advancing any of said brushes into mechanically co-operative relation to the corresponding row of fixed contacts, and means for imparting to the brush support a movement of translation to carry the selected brush along the corresponding row of fixed contacts.

INDUSTRIAL

ANALYSIS OF BOILER FEED RECORDS.

Some time ago in walking through a large boiler plant, where records of temperatures, coal consumption, steam pressure load, etc., are carefully made, the following water-level readings were noted.

Height of Water in 15 Different Boilers.

No. of Boiler.	Time 1:30 p. m.	Time 2:30 p. m.
13	1 in. from top of glass.	4 in. from bottom of glass. (Glass 16 in. long.)
14	1 in. from top of glass.	3 in. from top of glass. (Glass 16 in. long.)
15	Middle gauge.	Three gauges.
16	Full glass.	One gauge.
7	Three gauges.	Middle gauge.
18	Three gauges.	Middle gauge.
5	Middle gauge.	Middle gauge.
4	1 in. from bottom of glass.	1½ gauge.
19	1 in. from bottom of glass.	1½ gauge.
20	No water in glass.	Middle gauge.
21	Middle gauge.	1 in. from bottom of glass.
2	Just in sight at bottom.	1½ gauge.
1	Three gauges.	1 in. from bottom of glass.
22	Three gauges.	1½ gauge.
3	Middle gauge.	Middle gauge.

By the use of properly constructed automatic boiler-feed regulators these water levels would have been maintained within a fraction of an inch of normal height, with the result that regardless of the load, the rate of feed to each boiler would have been in proportion to the rate of evaporation.

This would not only have averted the possibility of burnt tubes and strains from low water, and excess moisture in the steam due to high water, but would have resulted in numerous other economies. Feeding in proportion to the rate of evaporation, by the use of automatic regulators, eliminates labor, smoothes out the operation of the boiler-room and results in the highest temperature of water fed to the boiler. The charts shown in Figs. 1 and 2 will serve to show the importance of proper feed water regulation in regard to feed water temperature. The chart of Fig 1 was taken in a plant equipped with an open feed water heater from which the supply of feed water was drawn and fed to the boiler by hand. In the case of Fig. 2 an automatic boiler feed regulator was used and the effect of feeding in exact proportion to the rate of evaporation is fully evident in the constant high temperature of the feed. This amounts to about 5 degrees more than the average obtained in Fig. 1 and is explained by the fact that the feed being in proportion to the rate of evaporation, is also in proportion to the boiler and plant load, and, therefore, in proportion to the rate at which exhaust steam was supplied from the auxiliaries to the open heater.

The earlier type of boiler feed regulator consisted of a float resting on the surface of the water in the boiler, which responded to the changes in water level, and opened or closed a feed valve through a system of levers. The same principle is to day used in many boiler feed regulators with special adaptations in the form of pilot valves and diaphragms, or else electro magnets, for utilizing the motion of a float to control a feed valve in the boiler supply line. However, the modern boiler evaporating water at a high rate presents difficulties which make the use of a regulator of the float type sluggish and ineffective.

A float or similar body has considerable weight, so that there must be a considerable rise in water level before the additional water displaced by the float can cause it to rise. Furthermore, the resistance of the levers connecting the float with the pilot valve tend to make the action of the regulator still more sluggish. As a result of this construction, the water level in a boiler may rise several inches before the regulator has closed the pilot valve and cut off steam from the diaphragm-operated feed valve, so as to stop the supply of feed water to the boiler.

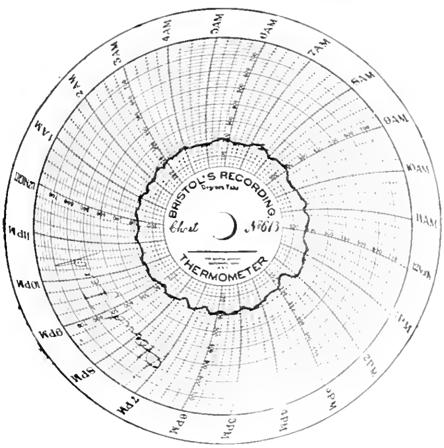


Fig. 1.

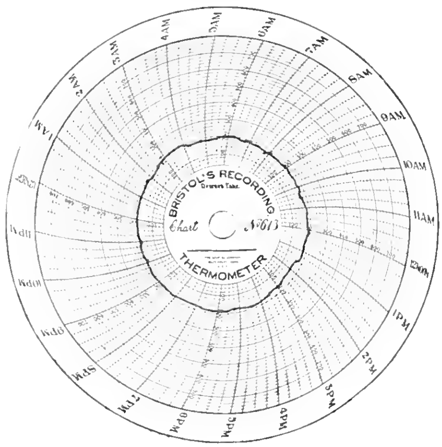


Fig. 2.

This action can best be explained by reference to the Venturi chart shown in Fig. 3. This chart was taken in the feed supply line to a B. & W. boiler equipped with a regulator operating on the float and pilot valve principle. The rate of feed for 24 hours as shown by the diaphragm, fluctuates up and down in a spasmodic and jerky manner. To further prove that this fluctuating record was due to the action of the boiler feed regulator, the engineer recorded the movements of the valve stem operated by the regulator and found that the opening and closing of the valve correspond exactly to the high and low points on the Venturi chart.

In contrast with this chart, the Venturi record shown in Fig. 4 was obtained when the same boiler was equipped with an automatic boiler feed regulator which operates on a distinctly different principle. In this case the feed valve consisted of an ordinary check which is connected by a sys-

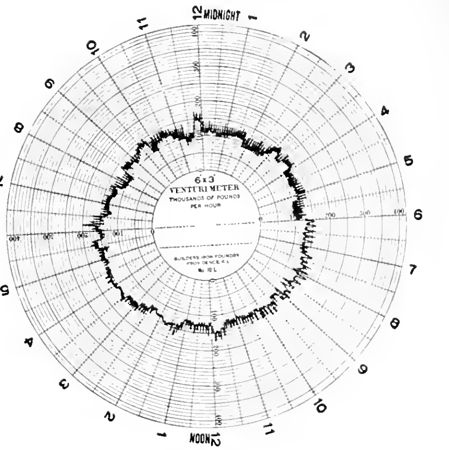


Fig. 3.

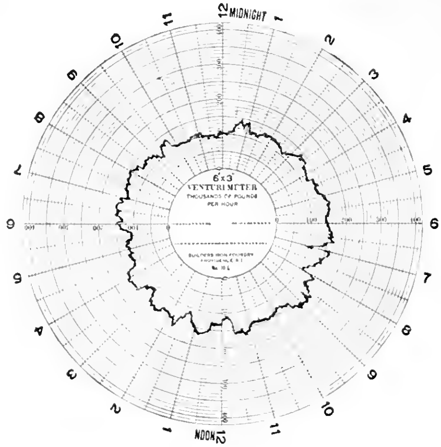


Fig. 4.

tem of levers, to a long tube which changes in length in accordance with changes in temperature. These changes in temperature depend upon the height of the water-level in the boilers. Connected to the top of the expansion tube as it is called, is a small tube running to the middle of the water column. Connected to the bottom of the expansion tube is a small tube connecting into the drain-pipe at the bottom of the water column. When the water in the boiler is above normal point, the expansion tube is filled with water. This water circulates very slowly and as heat is radiated the temperature falls and with it the temperature of the tube, thus causing contraction and closing of the feed valve. When the water level in the boiler drops below the normal point steam immediately flows into the expansion tube and holds

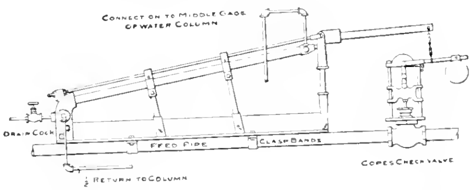


Diagram of Copes Boiler Feed Regulator Clamped to Feed Pipe

it at the temperature of the steam regardless of the amount of radiation. This temperature is maintained because just as soon as any steam is condensed to supply the heat of radiation, more steam takes its place. Thus, when the water level falls below normal, the tube is filled with steam, expands and allows the check valve in the feed line to open up, just as does any check valve, and admit water to the boiler.

If the boiler load is constant, alternate slugs of water and steam flow through the expansion tube thus causing the temperature to be at a mean between maximum and minimum. The length of the tube is also a mean and the check valve in the feed line opens far enough to feed water to the boiler in proportion to the rate of evaporation. A change in the load on the boiler, for instance an increase in load, causes the water level to fall, since the feed valve is not opened far enough to supply water at the increased rate of evaporation. The fall in water level reduces the amount of water flowing to the expansion tube and increases the supply of steam, so that the expansion tube heats up, expands, allows the check valve to open further and thus increases the rate of feed.

The expansion tube illustrated is of the special Copes construction, designed for extra heavy service. The heavy braces prevent any lateral or longitudinal strains or distortion, and the metal used for the tube has a high compressive strength combined with a high coefficient of expansion. It is to be remarked, however, that no large load comes upon the tube as the work of closing the feed valve is accomplished by the toggle motion and weighted level attached to the valve bonnet. Thus the only actual work performed by the expansion of the tube is to lift this small weight against the force of gravity. When the expansion tube contracts (due to rise in water level in boiler and the presence in the tube

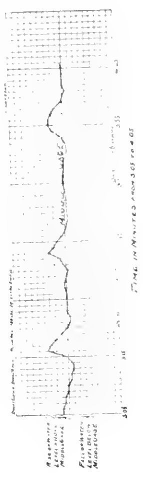


Fig. 5.

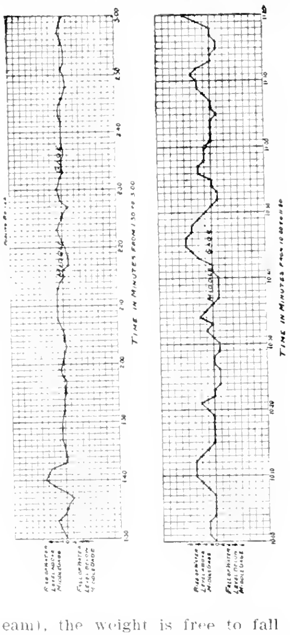


Fig. 6.

of water instead of steam), the weight is free to fall and therefore close the feed valve through the toggle lever. As is well known the force that can be exerted by a toggle joint becomes infinitely great the more nearly it straightens out.

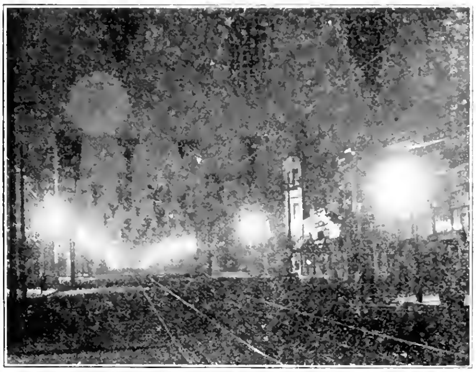
The difference between this type of automatic boiler feed regulator and the float type is clearly shown by the difference between the charts of Fig. 3 and Fig 4. The rate of feed with chart No. 4 is smooth and non-fluctuating. It varies in accordance with the load on the boiler plant.

As is evident, if a boiler feed regulator controls the rate of feed to a boiler in proportion to the rate of evaporation, the water level in the boiler must remain constant. The accurateness with which this can be accomplished by an expansion tube boiler feed regulator is shown by the charts in Figs. 5 and 6. Fig. 5 is a series of gauge readings obtained in the plant of the South Side Elevated Railroad Company, Chicago, and it is to be remarked that the load of the 400 h.p. boiler fluctuated considerably, running as high as 511 h.p. and that nevertheless, the water in the boilers remained within less than an inch of middle gauge.

Fig. 6 shows similar readings obtained at the plant of the St. Joseph Railway, Light & Power Company's plant. The readings were taken on a large B. & W. boiler equipped with Roney stokers, the load being considerably above rating. The upper chart in Fig. 6 was taken over a period of an hour and a half, the boiler load being especially heavy around 2:30. It is noticeable that there is no appreciable difference in the water level at that time; in fact, during the whole period the maximum change in level was less than one inch. The readings for the lower chart were obtained with the boiler operating under light load, the fire doors being alternately opened and closed as indicated. These changes had no appreciable effect on the water level maintained.

A LARGE FLAMING ARC INSTALLATION.

The largest Pacific Coast street installation of flaming arc lamps is that of Mission street, San Francisco, for the eight blocks between Sixteenth and Twenty-fourth streets,



Alba Flaming Arc Illumination along Mission St. San Francisco

giving about 120,000 candle-power of cheerful white light. This illumination is provided by 40 Alba flaming arc lamps furnished by Chas. L. Kiewert Company. The lamps were purchased and are maintained entirely by the Mission Street Merchants' Association, an organization which is less than a year old, but which has done much to improve the Mission district.

LIGHTING A PIER WITH FLAMING ARC LAMPS.

The amount of night work necessary to load and unload the cargo of steamships has made good artificial lighting necessary, and for single-story piers and those of two stories having ceilings of sufficient height, the flaming arc lamp, on account of its economical operation, great brilliancy and penetrating power, has proved the most satisfactory illuminant for lighting these large semi-open areas. An excellent example of pier illumination is afforded at the new pier of the Fabre Steamship Company at the foot of Thirty-first street, Brooklyn, New York.

This pier is the largest in or about New York, being 1476 feet long, 150 feet wide and 35 feet high. Being only one story in height, it is lighted during the day by means of skylights and whatever light comes in through the open doors.

The present lighting system, which has been in operation about three months, consists of twenty-four Hawthorn flaming arc lamps, twenty-two of which are hung inside the building and the other two outside the building, one at either entrance. The lamps are hung in two parallel rows, there being eleven lamps in each row, hung about 120 feet apart, the distance between the rows being 50 feet.

Power is taken from a 2200-volt, 3-phase, 60 cycle alternating current transmission line, which is brought into the

1500-Foot Steamship Pier Lighted With 24 Hawthorn Flaming Arc Lamps.

building near the front entrance and stepped down to 115 volts by a transformer. From the transformer a primary circuit of copper wire is run the length of the building. The entire lighting system is controlled by five control boxes, so wired that three of them control four lights each, and two of them six lights each, the lamps being connected two in series. This pier is so long that three vessels can be loaded at once, if necessary, and in that case all of the lamps would have to be burning. This seldom happens, however, a dozen lamps being a fair average load.

One of the obstacles met with in lighting this pier was the elevated platform shown in the illustration. It was thought at first that this platform, which extends the whole length of the pier, and is used for the convenience of passengers, would throw such a heavy shadow as to make the proposed plan of hanging the lamps impractical. It has been found, however, that while this platform is over eight feet wide, and but slightly below the level of the lamps, the row of lamps parallel to the platform, but about 50 feet from it, throws such a penetrating light as to almost entirely overcome all shadows.

As in the case of foundries, machine shops and other large interiors, it is a great advantage to be able to hang the lamps as high as possible on a pier. Take the case of the Fabre line pier; this line operates a line of ships between Naples, Marseilles and New York, and its cargoes are principally olive oil, olives, wines, raisins, nuts and grapes. The last three are extremely bulky, and when unloaded are often piled almost ceiling high

NEWS NOTES

INCORPORATIONS.

PORT TOWNSEND, WASH.—The Whidby Island Light & Power Company has been incorporated by I. L. Todd and others.

VANCOUVER, WASH.—The Cascades Light & Power Company has been incorporated by H. W. Arnold, W. P. Conway, A. Fiegel, H. G. Dorchester and E. Hughey, with a capital stock of $2,000,000. Water-power is to be developed in the north fork of the Lewis River.

OAKLAND, CAL.—With the filing of articles of incorporation of the Oakland and Bay Shore Railway Company last week certain San Francisco and Oakland capitalists showed their intention of securing seven miles of electric road in Oakland as a waterfront terminus for their Oakland and Antioch Railway Company which is now building an electric line in Contra Costa County, and which will soon enter Alameda County on its way to the city of Oakland. The Oakland and Antioch Company is to have 40 miles of electric road. The two companies combined will have 47 miles of railway, the construction and equipment of which will cost about $2,000,000.

TRANSMISSION.

SAN FRANCISCO, CAL.—Mortimer Fleishhacker, having put new capital into the Sacramento Valley Power Company, the corporation has been reorganized on a basis that will enable it to develop to capacity the water rights owned by it in the northern counties of California. The capitalization has been raised from $800,000 to $2,000,000.

TACOMA, WASH.—C. L. & W. Nicholas Lawson are advertising for bids for completing the Nisqually hydroelectric project. Work will include a bridge across Nisqually River, a conduit and reservoir, pressure pipes, power house, water wheels and generators, equipment for power house, equipment for Tacoma sub-station and transmission line. The estimated cost is $1,940,000. Hamilton F. Cronon is engineer of the project.

OROVILLE, CAL.—The big dam of the Great Western Power Company at Intake is completed, and the water of the Feather River is now running over it. The completion of this dam is the last of the construction on the Big Bend power plant. More than four years have elapsed since the Great Western Power Company began the construction of the plant. The dam is 85 feet above bedrock, 65 feet above the low water mark, is 276 feet long and has a width at the bottom of 75 feet. In its construction over three thousand carloads of cement were used.

TRANSPORTATION.

SAN DIEGO, CAL.—J. D. Spreckels has obtained a franchise to extend an electric line from Old Town to La Jolla.

OAKLAND, CAL.—The first 35-year franchise ever granted in the city has been given to the Oakland Traction Company for a line on Nineteenth avenue.

SEATTLE, WASH.—After the first of the year the Seattle Electric Company will electrify the present cable service on the Madison street line from Broadway east.

THE DALLES, ORE.—An electric railway from this place to Tygh Valley is proposed by farmers and citizens of this place and vicinity. It is thought that a canvass among the farmers would result in raising over $500,000 to float the proposition.

OREGON CITY, ORE.—F. M. Swift of this place is making a survey for a new road to traverse the rich Molalla territory. Eastern capital is to be interested.

WHITE SALMON, WASH.—The Mount Adams Electric Railway Company, W. W. Swan, president, of this place, will start work in the spring on the construction of the proposed electric railway.

SALEM, ORE.—It is rumored that the Oregon Electric Railway Company will erect a $75,000 reinforced concrete five-story building on the southwest corner of State and High streets just across the street from the Masonic Temple.

OAKLAND, CAL.—The City Council has passed to print the ordinance granting the Southern Pacific Company a 50-year franchise on Seventh street. The ordinance granting the privilege provides for a division of the net profits of the line on the basis of 25 per cent to the city and 75 per cent to the railroad.

PHOENIX, ARIZ.—Extensive improvements are being planned by the Phoenix Street Railway Company. New rails will replace the old ones from the capitol building east to Seventh street; bond wires will be removed and the entire track from one end of Washington street to the other will be rebonded.

GREAT FALLS, MONT.—An electric railway to connect this city with Lewiston, Idaho, is being planned by capitalists represented here by Col. H. H. Felloes of London, England. McDonald & Nissler, the local engineers, are engaged in making estimates on the work Col. Felloes is now engaged in purchasing the right of way.

LOS ANGELES, CAL.—The Jefferson Street Boosters' Association will present a resolution to the Board of Public Utilities at its next meeting setting forth the advantages of a cross town car line which the Los Angeles Railway Company is being urged to build, and to get which the association is working hard. The electric line will be an Jefferson street.

OLYMPIA, WASH.—The State Supreme Court has affirmed the conviction of F. A. Boutelle, superintendent of the Tacoma Railway & Power Company, for failure to maintain a five-minute service on the South Tacoma line. Boutelle was fined $100 in the Pierce County Court and appealed on the ground that the city had no right to restrict the franchise of the company.

SAN FRANCISCO, CAL.—The Oakland & Antioch Railroad, which is now under construction, will extend from Bay Point to Oakland via Concord and Walnut Creek, in Contra Costa County, through the county tunnel, through the Claremont district along the south side of Lake Temescal to Thirty-eighth street and College avenue. A branch will also be built to Martinez. The line is completed from Bay Point to Concord.

SAN FRANCISCO, CAL.—Specifications for general supplies and materials for the Geary street municipal railroad have been received from the city engineer and approved by the Board of Works. The Board will ask the Supervisors to set aside the following sums, and bids thereon will be called for: 30,000 redwood ties, $17,000; 530 tubular steel trolley poles, $17,000; 48,500 pounds of copper wire, $8000; rail bonds, $500; rail fasteners, $18,000; steel tie nuts and rods, $3000; total $68,000.

SAN JOSE, CAL.—At a special meeting the City Council passed a resolution over the veto of Mayor Davidson, declaring the franchises held by L. F. Hanchett for a railway on

Santa Clara street, null and void, and called on the Attorney-General to take steps looking to the banishment of the road from local railroad competition. A fight has arisen between the Mayor and Council, first over the lowering of the company's track to a new official street grade, and second over the proposal of the company not to use a grooved rail on Santa Clara street, where the street is paved with bitumen.

OAKLAND, CAL.—The first public action of the Oakland-Antioch Electric Railway to obtain its terminus in Oakland was made last week when Walter B. Fawcett, the company's representative appeared at a meeting of the Board of Education and requested it to sign a petition asking the city to grant the company a right of way for 350 feet along Shafter avenue, along the school site located at College, Pagoda and Shafter avenues. In order to gain the desired roadway along Shafter avenue it is necessary to obtain the signatures of property owners of 3000 front feet along that street. The Board refused to take the initiative in signing the petition. Fawcett was told, however, that if he obtained the signatures of other property owners no objection to the granting of the right of way would be offered by the Board.

SAN FRANCISCO, CAL.—The general offices of the United Properties Company will be in the Mechanics' Institute Building, where it will occupy the entire seventh floor. The development of the company's plans for the exploitation and upbuilding of its properties around the bay will begin without delay. In this connection it can be said that these plans include the laying out of a number of parks and the construction of a system of electric lines that will stretch clear around the bay from Oakland to San Francisco, via San Jose. In the south, around Bakersfield, a colonization scheme similar to that planned for the Sacramento Valley has been mapped out. The merger will supply light, power, water and transportation to the communities that are created, the water for irrigation having been first used in the development of power. The entire development, which is proposed, has been planned with great detail, together with the amount of capital that will be required at the end of each six months period.

ILLUMINATION.

SPOKANE, WASH.—The Spokane Falls Gas Company will expend large sums in improvements on its plant at Erie and Bradley streets, Spokane, announced A. Cantril, manager of the company.

GREENVILLE, CAL.—The Indian Valley Light & Power Company is planning an immediate extension of its lines from Taylorsville to Crescent Mills. J. R. Jones, secretary of the company, and O. C. Pratt, are now in Greenville inspecting the plans for the proposed work.

KLAMATH FALLS, ORE.—Attorney A. C. Hough, counsel for the Siskiyou Electric Company, is in this city in the interests of his company, and has placed a proposition before the City Council asking that it grant him a 50-year franchise for an electric light and power plant.

REDDING, CAL.—A plant for the manufacture of producer gas is to be installed in this county at once. The plant will be located on holdings of Fred H. Dakin, 30 miles east of this city, in Oak Run section. A syndicate, at the head of which is Mr. Dakin, will invest $100,000 in the plant.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Corporation will soon supply the Midway oil field with electric power as it has been supplying the Coalinga field for some time. Most of the materials for the construction work already are on the ground and work will be started in the near future.

ALAMEDA, CAL.—The necessity of a fireproof electric building is being urged by the electricity commission, and the City Council will probably be asked to call a bond election for the purpose of securing funds to erect the structure. It is estimated that a new reinforced concrete structure will cost $50,000.

WALLA WALLA, WASH.—Over two thirds of the electric light distribution system of the Pacific Power & Light Company of this city will be rebuilt this spring at a cost of about $9000, according to local manager W. B. Forshay, who has received word from Portland that his recommendations to this effect had been approved.

MEDFORD, ORE.—The Rogue River Electric Company, with headquarters at Medford will start work on its new plant at Prospect, early in the spring. H. C. Stoddard, secretary and consulting engineer of the company, is in the East at present consulting with Colonel F. Ray, the head of the company concerning the purchase of machinery.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—For the ten months ended October 31 the gross earnings of the Pacific Telephone & Telephone Company showed an increase of approximately $1,500,000 compared with earnings for the same period in 1909. Net for this period, however, showed only $2,523,106, as compared with $2,937,407 in 1909, a decline of $414,301. Decreased net, however, is easily explained by the large increase in the special maintenance reserve account. This reserve account is provided for from the expense account. During the last four months the amount laid aside applicable to this reserve account has averaged from $150,000 to $175,000 a month, one close to the company states, although the reservation for the first six months of the year was only $125,000 a month. On June 30 the liability account in the balance sheet showed $3,406,743 chargeable to special maintenance reserve. There will be no attempt to pay a common dividend, it is said, until this maintenance reserve has reached $5,000,000, although if the amount credited to this account in 1909 were included in the amount available for dividends for the common stock the latter would have earned 12.8 per cent and 14 per cent in 1910 to date. If the present rate of conserving reserve is maintained the $5,000,000 mark will be reached the latter part of 1911.

WATER-WORKS.

YACOLT, WASH.—The City of Yacolt is about to start work on the dam and pipe line at Big Tree Creek to be used to convey water to the city.

TACOMA, WASH.—The Council has adopted a resolution providing for the construction of a six-inch water main on Pacific avenue from South Fifty-fourth street to South Seventieth street.

CHICO, CAL.—J. H. Bowers of Oroville has filed a petition with the Board of Supervisors for the sale of a 50-year franchise to lay water mains along the county road and over the bridges of the county.

SEATTLE, WASH.—The Council has passed a resolution providing for the construction of water mains on Twelfth avenue northwest and on Twenty-fifth avenue north, according to plans prepared by the city engineer.

VICTORIA, B. C.—The desired water service for the district between the university school at the city boundary on Richmond road, as asked for by owners immediately outside the city limits, will be supplied by the city. The city will undertake the work and supply the piping.

DOUGLAS, ARIZ.—The Board of Water Commissioners of Douglas, Ariz., will receive sealed bids up to 1 p. m., January 19th for the construction of a water system for that city. The cost of the water-works complete is estimated at $85,000 and bids for a part or all of the work will be received.

INDEX TO ADVERTISEMENTS

JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVI | SAN FRANCISCO, JANUARY 21, 1911 | NUMBER 3

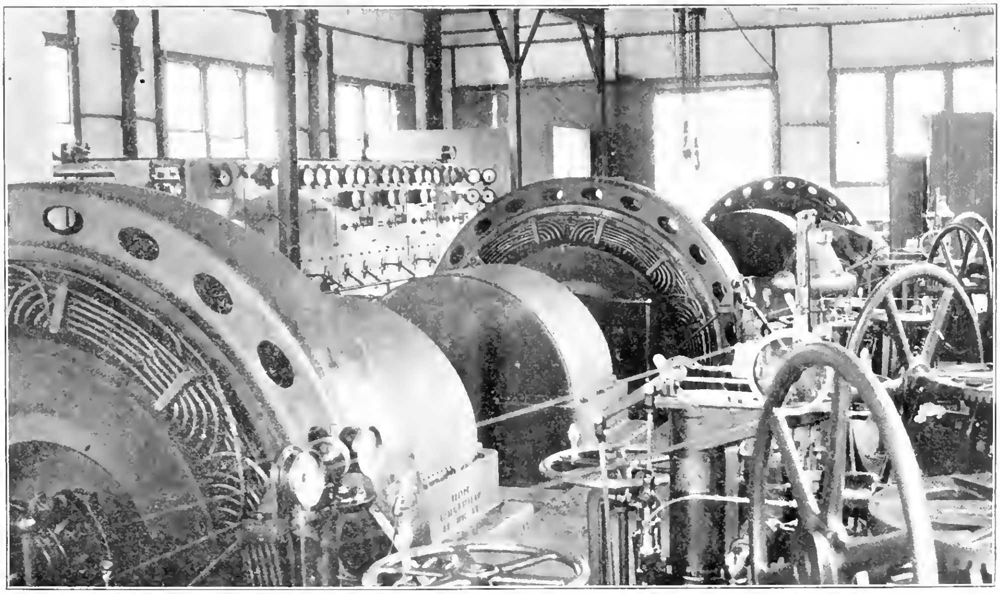
THE WAINIHA POWER DEVELOPMENT

Electric power for pumping water to irrigate the sugar plantations of the McBryde Sugar Company in the southern part of the Island of Kauai, Hawaii, is supplied from the Wainiha hydroelectric plant, thirty-five miles to the northwest, on the same island. During 1910 an additional 1200 kw. unit was installed, giving a total capacity of 3600 kw. in three units.

Wainiha Valley drains a great plateau in the northwestern part of the island, the highest point of which is Mt. Waialeale, which is considerably above 5000 ft., the average elevation of the plateau being 4000 ft. As this stream has the most constant flow of any on the island it was the best adapted for power development.

The diversion dam is located about four miles above the power-house at an elevation of 710 ft. The intake is through three 3-ft. head-gates, hand-operated by means of a rising screw stem.

The conduit consists of thirty-two tunnels having a total length of 17,400 ft. and eight connecting ditches with a combined length of 5600 ft., the gradient being 2 ft. to the hundred. All tunnels are through solid rock, the hardness of two of which required power drills. They are uniformly 6 ft. wide and 4 ft. high with an arched rise of 3 ft. The ditches were excavated with 5 ft. bottom, 9 ft. top and are 6 ft. deep. The slope on the high side is ¾ to 1, the berm 5 ft.



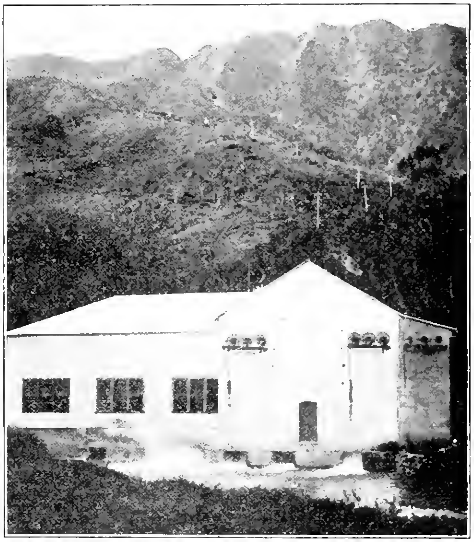
Interior of Wainiha Power Station

Wherever the conduit crosses streams or gulches aprons have been built to carry off excess storm water, the normal flow being added to that of the conduit, one stream, the Maunahena, supplying from 12 to 15 sec. ft.

The last tunnel delivers the water to a concrete-lined forebay excavated to a depth of 12 ft. in the ridge above the power-house. From the forebay three 42-in. pipes, 1700 ft. long, lead the water to the wheels under a head of 575 ft. These pipes are buried and are securely anchored at 150 ft. intervals.

The power-house is a steel frame building with concrete foundations and galvanized iron walls and roof. The main building is 80x40 ft., the transformers being housed in an adjoining concrete structure with a floor 6 in. lower. A 16-ton crane travels the length of the power-house, the transformer section being equipped with a smaller crane.

The three water-wheels are each 2500 h.p. Pelton impulse type with needle nozzles and Lombard and Pelton governors. They operate at a speed of 375 r.p.m. under an effective head of 575 ft. and each drives a 1200 kw. Westinghouse revolving field a. c. generator. Two 70 kw. d. c. generators supply exciting current. Current as generated at 2200 volts, 25 cycles, is steped up to 33,000 volts by means of 500 k.v.a. Westinghouse single-phase transformers, there being nine in service and one spare. They are delta-connected on both low and high tension sides.



Exterior of Wainiha Power House

The pole line passes through 35 miles of rough country from the power-house to the pumping stations. Much of the territory is heavily wooded and contains many transverse ridges and deep valleys The poles are 30 ft. round cedar timber, with 10 in. butts and 7 in. tops, buried to a depth of 6 feet. Before erection the butts were given two coats of crude oil, a third being applied when they were in place. Seven-stranded aluminum cable is used in the three-phase transmission line. No. 12 copper wire is used for the telephone circuit, transposition being made at every tenth pole.

After being stepped down at Station No. 2 current is distributed at 2200 volts to the three 1000-h.p. low speed Westinghouse pumping motors and to numerous smaller motors used for other purposes. This hydroelectric system is operated by the McBryde Sugar Company for the exclusive use of their plantations under the electrical superintendence of A. Menefoglio.

AN AUTOMATIC APARTMENT HOUSE SYSTEM..

BY GERALD DEAKIN.

At the present time, the demand for private exchange service in apartment houses is almost invariably met by the installation of a manually operated private branch switchboard. Such a switchboard at the best under conditions as they usually exist in apartment houses, cannot afford the occupants anything like the equivalent of good main or even party line service. The shortcomings of the manual switchboard are not due to poor design or to defective operating methods, but to the fact that such switchboards require constant attention on the part of some one if continuous and uniform service is to be given. In the larger apartment houses the services of an exclusive switchboard attendant can be afforded and such an attendant is nearly always provided, but in the smaller buildings, the expense of a switchboard operator is rarely warranted, therefore, the switchboard gets its attention, such as it is, from the janitor, bell boy or elevator boy as the case may be. Attendants so incumbered by other work, must, of necessity be absent from the switchboard a larger part of the time. The obvious result is that service to and from the apartment house is made to suffer and if the apartment houses be many, the efficiency of the service of the entire telephone exchange is soon impaired. In the best of apartment houses, private exchanges are rarely attended before seven or eight o'clock in the morning and after ten or twelve o'clock at night, thereby requiring doctors and others to whom continuous service is a necessity, to install additional facilities for telephone service.

Even where private branch switchboards are well attended, there are always moments during operating hours when calls must be considerably delayed due to a congestion of orders. Furthermore manually operated private exchanges in apartment houses, offer a source of gossip of which advantage is taken by inquisitive attendants. The conditions under which these attendants work are naturally different from those under which operators are employed in a central office. The former have many spare moments which may be filled in any convenient manner. The result is that many of them take a more or less active interest in the conversations carried on, and if maliciously inclined, spread the information thus obtained when occasion offers.

Apartments are generally taken on short term leases or agreements, and it is, therefore, advisable and even necessary when the cost is considered, that all apartments be provided with some sort of a continuous telephone service, for by so doing the constant placing and removing of telephones, which would otherwise be necessary, is eliminated. With all due respect to the ability and carefulness of installers, it may be said that their presence as a rule, does not improve the appearance of the tinted wall or the finished woodwork, particularly if they have occasion to visit the same place more than once or twice. It is for this and other reasons occasioned by similar considerations, that apartment house owners have in-

stalled so generally, manually operated private exchange switchboards.

In an endeavor to handle in a more satisfactory manner this important class of service, the writer has recently devised and put into service in a modern automatic telephone plant, an automatic apartment house system, whereby the necessity of a switchboard attendant is done away with. Some of the salient features and advantages of the system will be stated briefly.

1. An ordinary automatic telephone set without coin or other special attachment, apart from the calling device, is placed in each apartment.

2. Outgoing calls are made direct from the apartments without the aid of an operator. Each completed exchange call is recorded upon a meter forming part of the automatic switchboard installed within the apartment house. Calls to the telephone company for information, etc., are not recorded upon the meter.

3. The apartments are called direct from the outside, no attendant being required to distribute the calls at the apartment house.

switches, connectors, service meters and a fuse panel, all suitably mounted in a substantial cabinet. The front elevation of a fifty line cabinet with the meter door open is shown in Fig. 1. The service meters are mounted in strips just above the switches and fuses controlling the current supply. The fuse and switch equipment is placed in a fire-proof compartment. The meter door permits the reading of the meters and the manipulation of switches and fuses, but does not allow access to the remainder of the automatic switchboard. A front elevation of the switchboard with the front door of the cabinet removed is shown in Fig. 2. The terminal strips to which the house and trunk lines are attached are shown to the left of the service meters and fuse panel. The line switch side of the switchboard is shown in Fig. 3. The switchboard shown in the cut has capacity for fifty line switches, each of which, by means of a master switch, has access to anyone of a group of six outgoing trunks. The opposite side of the switchboard is shown in Fig. 4. Here are mounted the incoming trunk connectors, out trunk relays and

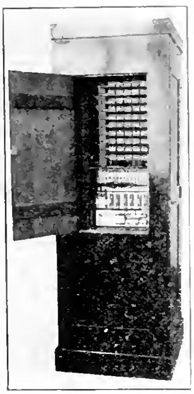


Fig. 1. Front View of Cabinet With Meter Door Ajar.

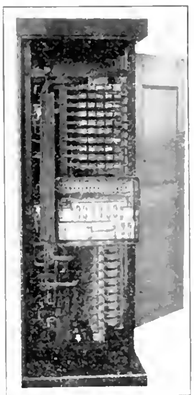


Fig. 2. Front View of Switchboard With Front of Cabinet Removed

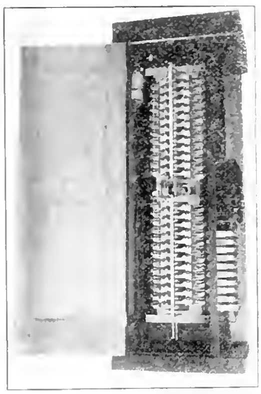


Fig. 3. Line Switch Side of Switchboard

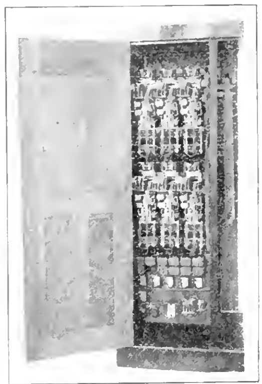


Fig. 4. Connector Side of Switchboard

4. A local call telephone, situated in the public office, janitor's quarters or the landlord's quarters, as the case may be, is installed in each apartment house. This telephone may be called by the occupants of the apartment house without cost to them. The telephone is for local service only and cannot be called from the outside, nor can calls to the outside be made from it.

5. Each apartment has twenty-four hour service, thereby eliminating slow or impossible connections.

6. Each apartment is afforded automatic secret service equivalent in every respect to main automatic service.

7. The automatic switchboard need not be placed in the office, corridor or other conspicuous place where space is limited. It can be placed in any convenient and dry location.

8. The expense of the services of a switchboard attendant is not entailed.

The small automatic switchboard installed within the apartment house consists of a combination of line

at the very bottom, the miscellaneous relays controlling the supervisory and ringing circuits.

At the central office the incoming trunks from the apartment house switchboard terminate on line switches precisely as any other line in a modern automatic telephone system of the present commercial type. The circuit at the apartment house is so arranged that upon the removal of the receiver from the switch-hook, the corresponding line switch on the apartment house switchboard automatically picks up an idle outgoing trunk to the central office and in turn causes the line switch, associated with the trunk at the central office, to automatically select an idle first selector. The calling subscriber is now connected to the automatic switchboard and may proceed to call the desired party in the usual manner. When the called party answers, the circuit conditions in the line are changed so as to cause the service meter at the apartment house to operate and register one additional call upon its counting train. At the end of con-

versation, the calling subscriber hangs up and releases the connection.

In listing automatic apartment house systems in the directory, the telephone numbers are divided into two parts, as for example, C-5517-43. The first part of this number, namely C-5517, pertains to the apartment house, and the latter part, namely, 43, to the individual apartment and where possible, coincides with the apartment number. To call the apartment whose telephone number is that just given, the calling subscriber calls C-5517 in the usual manner, and in so doing automatically selects an idle outgoing trunk circuit leading to the apartment house, there terminating the partially completed connection upon a connector. This connector differs in no way from the main line connectors used in the associated central office. The calling subscriber may now complete the connection by calling the digits 4 and 3 in the order given. When this is done the call bell in apartment 43, or whatever apartment corresponds to the number 43, will ring until the call is answered, or until the calling subscriber hangs up.

From what has been said, it will be seen that the service afforded by the automatic apartment house system is essentially equivalent to main line service, differing only in the fact that two additional digits are involved on incoming connections.

In placing this system in large apartment houses, it is generally possible to make the last part of the apartment house telephone number agree with the actual number of the apartment. Where, however, a group of small apartments are to be served, it is desirable that one switchboard be made to serve the group. Such an arrangement requires that the second part of many of the telephone numbers differ from the apartment number. Where this is the case, the objection to the difference in numbers is overcome by listing in the directory, under the apartment house, all the apartment telephone numbers. For the information of the public the telephone company keeps an up-to-date list of the occupants of all apartments in every apartment house equipped with automatic service. In this manner the information bureau of the telephone company removes the burden of inquiries from the management of the apartment house.

The switchboard previously described, makes use of separate incoming and outgoing trunks. The automatic system, however, can be readily adapted to the use of double track, two wire trunks, that is, to the use of trunks over which both incoming and outgoing connections can be made. This system can be further adapted to give free inter-communication between apartments and some one point within the apartment building, as for example, the office, landlord's or janitor's quarters and where desirable, between the various apartments in the building. To make a call from an apartment to the local office, landlord or janitor, as the case may be, an arbitrary number, such as C-05 is called. This causes a lamp to burn on the local telephone which is shown in Fig. 5. This telephone, as will be seen, is equipped with a key of the common inter-communicating type, having six buttons, one for each outgoing trunk circuit. Adjacent to each key is a lamp socket suitably mounted. Should the call to the local station happen to be made on out trunk number 2 for example, the lamp opposite button number 2 on the local telephone will light and at the same time, a buzzer will sound. The called party in answering depresses the button opposite the lamp burning and removes the receiver from the switchhook, thereby extinguishing the lamp and causing the audible signal to cease. The keys are of the automatic release type, that is, depressing one key will automatically release any other key that may happen to be depressed at that time. The local telephone can be connected with the out trunk circuit only when a lamp burns. In this manner secrecy is secured on all connections. It should be stated that in calling C-05 as mentioned, a connection of three numbers is not actually established. On the contrary, the automatic apparatus at the central office upon picking up the called number which would bring the partial connection to a third selector, is at once re-

Fig. 5. Local Call Telephone

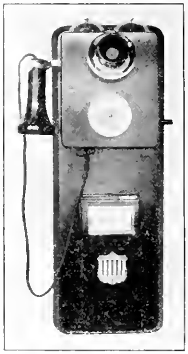


Fig. 6. Public Telephone With Coin Machine

leased and the out trunk circuit at the apartment house is automatically cut off from connection with the central office and in place thereof, connected to the local office telephone, with the results stated. The circuit thus arranged does not tie up any central office switching apparatus during local connections within the apartment house. Free intercommunication between apartments is accomplished in practically the same manner, except that the apartment telephone number is also called, as for example, C-05-43. This number, called would connect the calling apartment to the apartment whose telephone number is 43.

The system as installed and working permits the use of coin machines. A telephone so equipped is shown in Fig. 6.

The current for the operation of the switchboard is obtained from a battery of twenty-four small storage cells, the whole floated across a pair of wires from the central office or across the local direct current lighting mains if such exist. In either case, the potential of the charging circuit used is 110 volts, a bank of lamps is used to reduce the current to the required value. By floating the battery in this manner, the potential of the current supply at the switchboard is kept approximately constant. The battery is mounted in a substantial oak carrying case and is practically fume proof and for this reason may be placed in any

convenient location without objection. At intervals of every six months or less, it is the intention of the telephone company to replace all portable storage batteries by fresh ones, and bring the old ones in for overhauling, after which they will again be placed in service. The changing of the batteries involves merely the labor of removing four wires from the terminals of one battery and connecting them to the terminals of another. Where a number of closely adjacent switchboards exist one battery will suffice for the group.

The automatic switchboard has a decided advantage over the manually operated switchboard when it comes to the question of location. The manually operated switchboard must be placed close to or in the public office, if the switchboard attendant is to do anything but operate. A switchboard so located must be finished to match the surrounding woodwork and it is sometimes costly and difficult to bring the room wiring and cabling to the switchboard. The inspection of the switchboard in a public place during working hours is always objectionable to both the attendant and the proprietor of the apartment house. The automatic switchboard on the other hand, may be placed in any convenient location, providing it is reasonably dry. It has been found that an automatic switchboard may be placed without trouble in the finished basement of the average modern apartment house. It is recommended, however, particularly in new buildings, that the switchboard location be arranged for near the wiring center, for by so doing the amount of room wire required is reduced to a minimum and the switchboard is placed above the first floor.

The new system being on a measured service and coin machine basis, makes it possible to easily arrive at terms which are agreeable and beneficial to both the telephone company and the proprietor of the apartment house. The elimination of the switchboard attendant is one feature in the new system that appeals strongly to the lessee.

H. M. BYLLESBY ON PUBLIC SERVICE COMMISSIONS.

In his address of welcome at the second annual convention of the officers and employes of H. M. Byllesby & Co., Chicago, Jan. 17-21, Mr. Byllesby said that the men who had the courage and the faith to invest their own fortunes, great or small, and by sacrifices of every description to induce the investing of additional capital in the betterment of this business at a time when it was looked on as experimental and chimerical and unprofitable, deserve a fair hearing at the hands of the public and that alongside of their derelictions should be placed the overwhelming number of benefits they have conferred upon the community at large. Because some of the pioneers and prominent workers of the public service business, as the result of years of toil and conscientious industry, along with certain human errors and mistakes have amassed independent fortunes, we should not close our eyes to the fact that the great numerical majority died heartbroken and in penury.

It would appear that the world has advanced to a point where controversies should be handled in an advanced and enlightened spirit—where heartburnings and unfair advantages or arguments on one side or the other of the case should be avoided. It would appear monstrous that the policies of a mercantile association or corporation should be reviewed and governed by a board composed of physicians, clergymen and lawyers. It would be perhaps equally inappropriate if the same mercantile organization were to have its affairs passed upon and rules made for its government by a board made up of public service officers and of farmers, and so on through the category.

On the broad question of public service commissions there is no objection to the public service commission per se., but a very earnest plea is made that the public service commission should be composed of men of integrity and of ability, and men who have had a previous experience in the business in regard to which they are proposing, under color of a law, to pass regulations and rules.

A large part of the present unrest and antagonism between corporations and the commissions and lawmakers would disappear if the corporations appeared before bodies composed of, as we have previously briefly referred to, men of breadth of vision, free from favoritism and who had a working knowledge of the problems confronting the enterprises upon which they are passing.

ELECTRICAL MACHINERY IN CHINA.

While the imports of electrical machinery and appliances into China at present do not exceed a million dollars per annum, there is almost no limit to the possibilities of such imports were the matter of supplying light and power to the large cities open to foreign trade and influences properly exploited. In these cities there is a demand for electric service, but the lack of capital among those who appreciate the value of the new force in commerce and industries and the general ignorance which prevails as to the manner of using the same retard its building up by local financiers, and foreign capital does not seem to be attracted where it would not only have to build the light and power plants but where it would have to instruct the consumers in its uses to a certain degree. But these things overcome, as they can be overcome, there is no limit to the business which is possible

The matter of having special agents in China to represent American electrical, railway, factory, and other machinery is of vital importance, if contracts are to be secured, for the following reason:

There are in China few Chinese engineers who are trained by experience or otherwise to lay out any sort of industrial plant, technically, from beginning to end; who can, for example, draw up specifications for an electric light and power plant, indicating the nature and capacity of dynamos and engines, the technical requirements of switchboards, converters, and all the several portions of a complete and properly co-ordinated electric plant. There are few if any Chinese engineers capable of economically and safely planning for traction power of railways, for grades and curves, and locomotives to overcome them with loads economically calculated. All these things come within the work generally given to foreign engineers in connection with Chinese as well as foreign companies.

HISTORY OF SAN JOSE AND ITS GAS BUSINESS.

BY E. C. JONES.[1]


E. C. Jones

In a letter, dated June 3d, 1777, Don Felipe de Neve, the third Spanish governor of all Upper California, requested authority from the viceroy of Mexico to establish a pueblo on the banks of the river Guadalupe, near San Francisco Bay. Receiving no response from the City of Mexico and realizing the importance of having a settlement in the beautiful Santa Clara Valley, close to the Mission of Santa Clara which had been established January 18th, 1777, Governor Neve ordered Don Jose Moraga, lieutenant-commander at the Presidio of San Francisco, to detach from that garrison soldiers skilled in agriculture and others to make up a little band of fourteen settlers. These settlers, headed by the lieutenant-commander, located on the present site of San Jose November 29th, 1777. They designated their camp as a pueblo, and took for its protective divinity Saint Joseph (in Spanish, San Jose). The establishment of this new pueblo by Governor Neve was approved by the King of Spain in a letter dated March 6th, 1779.

The 24th of December, 1872, Don Jose Moraga was appointed a commissioner to go to San Jose and, in the name of His Majesty the King of Spain, was instructed to give title and legal possession to the nine founders of all their cultivable lands, house lots, and the iron brands to mark their cattle.

November 20th, 1792, Captain George Vancouver visited the Santa Clara Valley, and in his sketch of the trip he described it thus:

> We considered our course parallel to the sea coast, between which and our path the ridge of mountains extended to the southeastward; and as we advanced, their sides and summits exhibited a high degree of luxuriant fertility, interspersed with copses of various forms and magnitude, and verdant open spaces encircled with stately fruit trees of different descriptions. About noon we arrived at a very pleasant and enchanting lawn, situated amid a grove of trees at the foot of a small hill, by which flowed a very fine stream of excellent water. We had not proceeded far from this delightful spot when we entered a country I little expected to find in these regions. For almost twenty miles it could be compared to a park which had originally been planted with the true old English oak; the underwood, that had probably attained its early growth, had the appearance of having been cleared away and had left the stately lords of the forest in complete possession of the soil, which was covered with luxuriant herbage and beautifully diversified with pleasing eminences and valleys, which, with the lofty range of mountains that bounded the prospect, required only to be adorned with neat habitations of an industrious people to produce a scene not inferior to the most studied effect of taste in the disposal of grounds.

The Spaniards informed this distinguished English voyager that the Indians were in a state of inactivity and ignorance. These Indians were the discoverers of the cinnabar deposits which eventually became the New Almaden Quicksilver Mine. They used the red pigment to adorn their faces and bodies. This coloring matter was highly decorative, but its use resulted in all the symptoms of mercurial poisoning, with disastrous results.

The buildings of the first pueblo were located about a mile and a quarter north of the present city of San Jose. The limits of the pueblo included the ground covered by the present city and extended far beyond.

The first houses were built near the little stream crossed by the first bridge on the road leading from San Jose to Alviso. In 1798 the house of the ayuntamiento was built. This was a one-story adobe building having three rooms. It was located on what is now Market street, near the corner of El Dorado street. Its rooms were used as a court as well as a jail, and one of them was the office of the alcalde. This old building was torn down in 1850.

The good Fathers of the Mission of Santa Clara realized the wonderful agricultural advantages of this valley, and sowed the seeds from which the harvest is now being gleaned. The beautiful trees which line the Alameda between San Jose and the Mission of Santa Clara were planted in 1799 by Father Maguin de Catala, assisted by two hundred Indians. These rows of willow trees are now the pride of "the Garden City."

The first permanent foreign settler in the valley was John Gilroy, a Scotchman, who landed in Monterey in 1814. At that time San Jose had only about twenty houses. Gilroy finally settled on a ranch, about thirty miles south of San Jose, near the town now bearing his name. Before the year 1820 there was but little business in the valley. The manner of living was primitive. This condition continued until the Americans came in 1846.

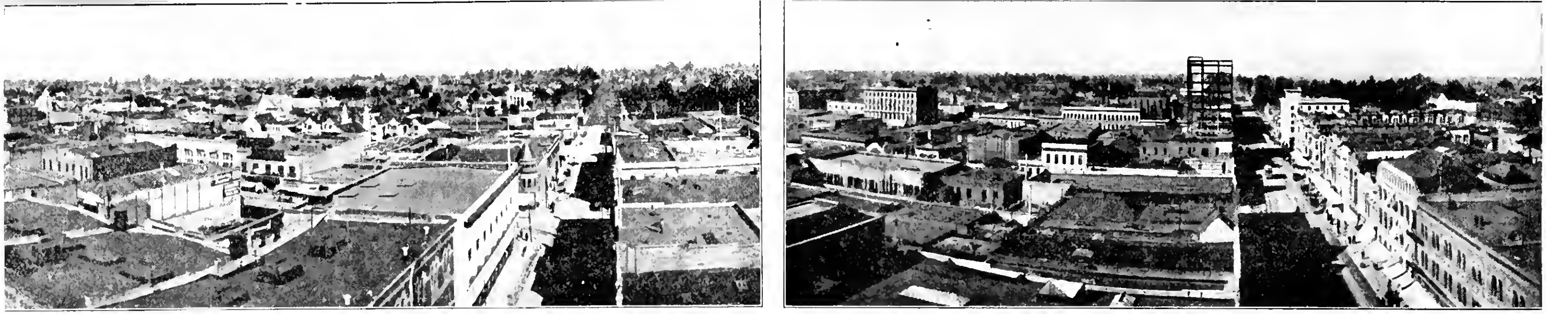
In 1831 San Jose had a population of 524. After the revolution of 1836, Governor Alvarado came into office. At that time Monterey was the Mexican capital of California. He was desirous that his name should be connected with the pueblo of San Jose. He insisted for a while in leaving off the name Guadalupe, the patron saint of Mexico, and substituting the name Pueblo San Jose de Alvarado. This change, however, was short-lived.

It was in San Jose that Jose Castro, a lieutenant-colonel of cavalry in the Mexican army and the acting general commander of the department of California, received the proclamation of Commodore Sloat the 9th of July, 1846, declaring that thenceforth California would be a part of the United States, and that its peaceful inhabitants would enjoy the same rights and privileges and the same protection accorded in any State in the Union. The 13th of July, 1846, the first United States flag was raised on the pole which had been erected by the Mexicans in front of the ayuntamiento.

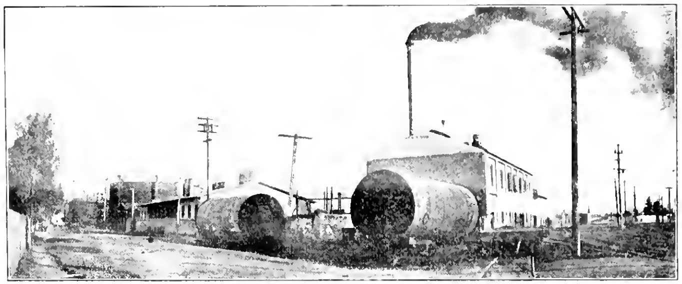
The discovery of gold in California in 1848 nearly depopulated San Jose. Crops that were sown that year were never harvested. It was then that Don Luis Peralta, one of the first settlers of San Jose, gave this sound advice to his sons: More would be gained by remaining on the ranches and raising grain to feed the miners than by deserting the beautiful valley in search of gold.

When the convention to form a State constitu-

[1] Chief Engineer Gas Department, Pacific Gas & Electric Company.



Looking North Through the Business Center Toward the Railroad Station in San Jose, a "Garden City" Claiming a Population in 1910 of 35,000



General View of the Gas Works at San Jose in 1910

Prune Trees in Blossom in Foothill Orchards, Near San Jose.
The large white mass in the background is Alum Rock, in a famous picnic canyon

The Company's New Office in San Jose

What the Earthquake Did at the Gas Works in San Jose

tion was held in Monterey in September, 1849, the people of San Jose exerted every influence to have San Jose selected as the permanent seat of government. Dr. Robert Semple, president of the convention and member from Benicia, urged that the first session of the legislature be held in Benicia, but forever after at San Jose. This did not meet with the views of the San Jose delegates. A vote was carried in favor of San Jose, and the first formal meeting of California's legislature was held at San Jose Saturday, December 15th, 1849.

In 1850, a tri-weekly stage line to San Francisco was established. The fare was $32, or as it was then expressed, "two ounces." Before that the fare by way of Alviso had been $35. During the following ten years the growth of the town was rapid and substantial.

By 1860 San Jose was large enough to warrant the introduction of illuminating gas. October 6th of that year James K. Prior, Thomas Anderson, and James Hagan formed the San Jose Gas Company. This corporation had a capital stock of $21,000, and was incorporated for a period of forty years from the date of filing the certificate.

Gas was first lighted in San Jose the 21st of January, 1861. It was supplied to eighty-four consumers. There were seven street lights. The price of gas was $10 the thousand cubic feet. The sales of gas for the first year amounted to 165,000 cubic feet.

An exclusive privilege to supply gas in San Jose had been granted to the incorporators on certain conditions. One of these conditions, contained in the ordinance granting the franchise, was:

Section 8—That if it shall appear at the expiration of five years from the date hereof that gas can be furnished for less than now, having reference to the price of labor and material used in the manufacture of gas, coal now being rated at fifty-three dollars a ton, it shall then be lawful for the city authorities to make such reduction as in their discretion shall seem just, so that the rates shall not be less remunerative than they would be now; and at the end of ten years a like reduction may be made, should labor and material still further reduce.

Railroad communication between San Francisco and San Jose was not established until 1865. Before that date coal was brought to Alviso in sailing vessels or in barges, and from the Alviso landing it was hauled to San Jose, a distance of about nine miles, over roads which were in bad condition at all seasons of the year and during wet weather were impassable owing to the overflow of the streams which enter the bay at or near Alviso. During the periods of overflow the coal used for gas-making was carried from Alviso on pack mules. It is recorded that often these mules with their burden of coal would be swept away by the torrent while fording some stream, and both mule and coal lost beyond recovery. So there is probably quite a deposit of coal and mules somewhere in the Alviso flats.

The first gas-holder built in San Jose had a capacity of 8000 cubic feet. The material used in the construction of its tank was redwood planks three inches thick. This gas-holder was in continuous use twenty-eight years. When torn out in 1888 the redwood tank was found to be in as good condition as when it was built. Some of those very redwood planks were then used in the construction of buildings about the gas works.

In 1865 a special committee of the city council made an investigation of the business and profits of the San Jose Gas Company. The report showed that the original investment of the gas company in 1860 was $21,000; that during the first five years of its existence the total expenditure for betterments, materials, and labor in the business of gas manufacture was $55,637.93; that the receipts from gas sales during that period amounted to $75,617; and that the three founders of the company had divided in dividends within the five years $19,979.52, or almost the equivalent of their original investment.

The formal history of the various light companies in San Jose is best given in the following short extracts from the county clerk's records:

165. James K. Prior, Thomas Anderson, and James Hagan formed a corporation by the name of "The San Jose Gas Company" for the purposes of manufacturing gas in the city of San Jose and supplying the city with same, gas to be manufactured from coal and other substances. Capital stock of $21,000, divided into 210 shares, $100 each, for a period of 40 years from date of filing of certificate. Principal place of business of the company, city of San Jose. Dated October 6th, A. D. 1860.

215. Increase of stock of the San Jose Gas Company 9th day of June, A. D. 1877, increased to $600,000. The whole of the original capital stock, to wit $20,000, has been paid in, and said corporation has no liabilities. Austin Roberts, Secretary.

240. Amended certificate of Incorporation of San Jose, Gas Company, dated February 25th, 1879. James K. Prior, Thomas Anderson, and James Hagan incorporate, that the name of said company is and shall be the San Jose Gas Company. Capital stock is $600,000, divided into 6000 shares, par value $100 each; to continue in existence for period of 40 years from and including October 6th, 1860.

272. San Jose Brush Electric Light Company. Articles of Incorporation to carry on business of lighting the city of San Jose by means of electricity, etc. Term 50 years. Capital stock $100,000, 10,000 shares, $10 each.

DIRECTORS	RESIDENCE
James A. Clayton	San Jose
Pedro de Saiset	San Jose
Thomas Rea	San Jose
T. S. Whipple	San Jose
Geo. H. Roe	San Francisco

Dated Feb. 25th, 1882.

390. Articles of Incorporation of Electric Improvement Company. Place of business of said corporation City and County of San Francisco, State of California. Term 50 years.

DIRECTORS	RESIDENCE
Frank Butterworth	San Francisco
Aug. J. Bowie, Jr.	San Francisco
Wm. H. Howard	San Mateo
J. B. Randol	New Almaden
Louis T. Haggin	San Francisco
Frederick Sharon	Belmont
Henry C. Dreger	

Capital stock $5,000,000, divided 50,000 shares, $100 each. March 30th, 1887.

357. Amended Articles of Incorporation of the San Jose Brush Electric Light Company, to generate, transmit, and sell electricity, electric light, and power, to manufacture, purchase, and sell gas, to purchase, lease, sell, and rent lands, tenements, and hereditaments. To buy, hold, and sell shares of stocks in any and of any corporation. Dated May 16, 1887.

Principal place of business San Jose. Term of years 50 from and after incorporation. Same directors for first year. Capital stock $100,000, divided into 10,000 shares, $10 each.

440. Electric Improvement Company of San Jose. Articles of Incorporation. To engage in business of electricity in every branch connected with it in any and every shape, form, manner, or purpose whatsoever &c. Term 50 years, place of business San Jose.

DIRECTORS	RESIDENCE
C. W. McAffe	San Francisco
T. C. Van Ness	San Francisco
A. J. Bowie	San Francisco
H. J. Edwards	San Jose
James W. Rea	San Jose

Capital stock $100,000, 5,000 shares, $20 each.

440. Creation of Bonded Indebtedness, March 29, 1889, $60,000.

428. Articles of Incorporation of the San Jose Light & Power Company. To manufacture, purchase, and sell gas, to generate, transmit, and sell electricity, electric light, and power. Principal place of business San Jose, Santa Clara County, Cal. Term 50 years.

DIRECTORS FIRST YEAR	RESIDENCE
Chas. Otter	San Jose
H. H. Kooser	San Jose
E. W. Clayton	San Jose
Chas. A. Hagan	San Jose
H. J. Edwards	San Jose
C. T. Ryland	San Jose
Amasa Eaton	San Jose

Capital stock One Million (1,000,000) Dollars, divided into 10,000 shares, $100 each. Dated June 20th, 1889.

473. Certificate of creation of bonded indebtedness San Jose Light & Power Company, passed resolution 16th day of August, 1890, to raise money to enlarge capacity for manufacturing gas, electric light, and power. Created bonded indebtedness of $60,000. Sixty bonds, each of the face value of $1000, to run 10 years, bearing interest 6% per annum, payable semi-annually.

709. Articles of Incorporation San Jose Lighting Co. June 3d, 1895. To build, construct, own, &c plants for manufacturing gas and electricity for lighting, heating, power, &c. and sell and distribute gas, electricity, &c., to lay down mains and erect poles, lines, &c. in San Jose. Term 50 years. Capital stock $250,000.

DIRECTORS	RESIDENCE
Chas. F. Wilcox	San Jose
Joseph R. Patton	San Jose
William H. Summer	San Jose
Reinhardt L. Stock	San Jose
J. J. Sontheimer	San Jose

1158. Articles of Incorporation United Gas & Electric Co., purposes to engage in the business of manufacturing, generating, and purchasing gas, electric current, and electric energy &c. Principal place of business, San Francisco. Term 50 years.

DIRECTORS	RESIDENCE
C. E. Green	San Mateo
W. Gregg, Jr.	San Francisco
C. H. Pennoyer	San Carlos
C. O. Poole	San Francisco
J. E. Green	San Francisco

Capital stock $2,500,000; divided 25,000 shares, $100 each. April 17th, 1902.

729. (709) San Jose Lighting Co. Certified copies of resolution of board of directors changing principal place of business of said company from San Jose, Santa Clara County, Feb. 1st, 1904, to City and County San Francisco, California, room 1014 Mutual Savings Bank Bldg., 708 Market street.

July 1st, 1902, the Electric Improvement Company and the San Jose Light & Power Company were acquired by the United Gas and Electric Company. In merging these two companies a lease was acquired of the building on Market street, formerly occupied by the "Evening Herald." The building was fitted up for offices, then the offices of the Improvement Company on West Santa Clara street and those of the San Jose Light & Power Company on Fourth street were vacated. There was also a concentration of all the gas interests of the new corporation on San Augustin street, on the former site of the gas plant of the San Jose Light & Power Company. At that time the intention was to build a high-pressure pipe-line up the peninsula as far as San Mateo, but the project was never undertaken.

Many names familiar to the gas men of the Pacific slope are connected with the history of gas-lighting in San Jose. Charles W. Quilty, who was the second president of the Pacific Coast Gas Association, was for many years president of the San Jose Light & Power Company; and Harry J. Edwards, affectionately spoken of by his friends as "genial Harry Edwards," was intimately connected with the lighting interests of San Jose almost from the inception of the business. Harry Edwards, one of the moving spirits and the manager of the Electric Improvement Company, was afterward manager of the United Gas & Electric Company, and the district manager at San Jose of the Pacific Gas & Electric Company until his death, which occurred July 10th, 1909.

James K. Prior remained in the gas business in San Jose until March, 1899. The reason he gave for resigning from the company was that he was desirous of bringing about a consolidation between the San Jose Light & Power Company and the Electric Improvement Company. The negotiations fell through, but eventually the consolidation was accomplished.

The position of superintendent of the gas works at San Jose has been filled by many men well known to the gas fraternity. John Fullager was superintendent from 1889 to 1890. Then came Peter E. de Mill, Jr. He was the son of Peter E. de Mill, of Detroit, Michigan, the founder and first vice-president of the American Gas-Light Association, the first meeting of which was held in Cleveland, Ohio, in September, 1872. It was while Peter de Mill, Jr., was superintendent of the San Jose works that modern coal benches were installed and the present storage holder was built. Following de Mill came O. M. Gregory, from 1892 to 1901; H. O. Byerly, from 1901 to 1903; J. R. Thompson, from 1903 to 1904; and R. H. Hargreaves from 1904 to the present time.

The United Gas and Electric Company, which now manufactures the gas supplied to San Jose, is a part of the Pacific Gas & Electric Company.

The progress of gas-making in San Jose has kept abreast of the times. San Jose was one of the first cities on the Pacific slope to introduce the manufacture of water-gas. The works is now equipped with a modern oil-gas process, and a new storage gas-holder of 500,000 cubic feet capacity is being erected.

The gas business in San Jose has grown from its eighty-four consumers in 1860 to its 5042 of today. The city is covered by a network of seventy-eight

miles of street mains, supplying these consumers. During the fifty years the price of gas has been reduced by successive stages from $10 the thousand cubic feet to the present rate of $1.25. The price of gas in San Jose now is as low as in many of the large eastern cities. This is due to the refinement of the process of manufacture and to the use of California petroleum, which produces a gas of excellent quality.

Although it may not be considered good form to refer to the catastrophe of 1906, yet it must be touched upon in order to give credit to men who worked so faithfully and unselfishly at the time of the great California earthquake. San Jose was almost on the geological fault line, and suffered as much as any town in the path of the earthquake. A glance at the accompanying picture taken at the works shortly after the disaster will give some idea of the devastation of property belonging to the gas company. The damage to the gas works was so great that Superintendent Robert E. Hargreaves found it necessary to turn the gas off from the city because the relief holder, the purifiers, and the scrubbers were in a dilapidated condition. The evening of April 18th the gas generator was heated up, ready, without the loss of a day, to make gas. But the gas services and house fixtures throughout San Jose were in such condition that it was not deemed advisable to turn on the gas until April 24th. By the 26th of April more than seven hundred gas meters were in use. During those strenuous days Harry Edwards, ably assisted by Robert Hargreaves, almost performed miracles in repairing the gas works and the distributing system so that gas could be supplied to the city of San Jose after an interruption of but six days.

After the death of Harry Edwards his mantle fell upon the shoulders of John D. Kuster, who was formerly manager of the Pacific Gas & Electric Company's Fresno Gas & Electric Company. John Kuster is an able man of force, and possesses many of the qualities which endeared Harry Edwards to the people of San Jose, so that no more happy selection of a successor could have been made.

The company has recently moved its offices into modern and well-equipped quarters, under the direction of John Kuster.

During the spring months of 1910 the gas distributing system of San Jose was enlarged and improved so that no city in California had a better gas service.

The writer in preparing this article has drawn freely from the "History of San Jose" by Frederic Hall (1871) and "Auld Lang Syne" by T. R. Parker of Napa.

THE ULTIMATE DEVELOPMENT OF AN ISOLATED PLANT.

In discussing the relative position of the isolated plant and the central station it is usually assumed that the former is a power plant which produces light and heat for the use of the building in which it is located as opposed to the central station which produces power at one point to be used in buildings more or less distant from the source of supply. A rather unusual case of an isolated plant which developed in course of time into a small central station, is presented by the power development of the Wells Power Company of Milwaukee, Wis.

This power plant was originally intended to furnish light, power and heat for the building in the basement of which it was situated. Later, however, it developed that the plant was able to produce enough electrical energy to supply several of the neighboring buildings at a very low figure and with reasonable profit. From this start the power business of this enterprise has developed until at the present time the Wells Power Company is supplying customers in the heart of the business section of Milwaukee not only with electric current but also with exhaust steam for heating.

The original power plant was soon outgrown and it was decided to go into the power business on a larger scale by building a new plant in the basement of another building owned by the company at a short distance from the old power house. The firm of D. C. & Wm. B. Jackson, engineers, of Chicago and Boston, was retained to design and supervise the construction of the new plant. In view of the previous growth of the company's business and the bright outlook for future expansion the engineers made provision throughout the design for a large eventual increase in equipment. This added equipment is to be installed unit by unit as the increase of load warrants. At present less than one-half of the ultimate capacity of this station has been installed, yet the total kw. hours generated during the year from July 1st, 1909, to July 1st, 1910, was 1,561,410 and customers were supplied over an area of about 2½ square miles in the center of the city.

In order to be able to operate the power stations as efficiently as possible the policy has been adopted of accepting no heating contracts without the accompanying lighting contract although lighting is sometimes supplied without steam heat. By this means the load factor of the generating units is kept high and also an inordinately high back pressure is guarded against. The main generating units are driven by cross compound reciprocating engines, this type being selected because of its ability to operate efficiently against a back pressure and in the summer to give a reasonably good economy at atmospheric exhaust. The wisdom of this selection has become evident since the new station has been in operation as the engines when operating against two pounds back pressure (an amount which is rarely exceeded) produce an indicated horsepower on 20 pounds of steam. The lighting and heating loads are so well balanced that it is rarely necessary to use live steam for making up a deficiency in the heating supply.

Because of the peculiar conditions under which this plant operates, for some time it did not realize the economy which had been hoped. However, Messrs. Jackson, the designers, were commissioned after some months of unsatisfactory operation, to take charge of the plant and under their supervision the results have been most satisfactory. Whether regarded as a small central station or as the final development of an isolated plant the history and present situation of this installation is probably unique.

RULES FOR ELECTRIC WIRING AND APPARATUS IN SAN FRANCISCO.[1]

Specifications and Permits.

1. Upon the personal appearance at the office of the Department of Electricity of an authorized representative of the firm or individual proposing to install any electrical work in, on or about buildings and the filing by him of the requred specifications, a written approval will be issued in each instance by the chief of said department. Applications received by mail will not be recognized.

2. The written approval will be in the form of a permit to install electrical wires or devices in or on the premises described in the specifications filed, and this permit shall be conspicuously posted on the front of the building until completion of the work.

3. No electrical work shall be performed in, on or about any building or other structure or on or over any street until such approval permit has been issued by the Department of Electricity.

4. Before commencing work, notice of the proposed time of starting must be given in each instance to the Department, as well as reports of progress of the various stages requiring inspection and a notice of date for making final approval. In the case of electric signs, manufacturers must in each instance, before closing the same, notify the Department and secure inspection before signs leave the shop.

5. For all office, apartment, hotel or other buildings of a like character, in which the first or mezzanine floors are designed for stores, shops, nickelodeons, theatres or other business occupancy, a separate specification form must be filed for each sub-division and another for the combined floors above the first, for which respectively written approvals will be issued.

6. The Department will immediately revoke the certificate of registration of any person or company allowing others to file specifications under his or their license, and will prosecute those who illegally use the same.

No requests for inspection will be received by telephone between the hours of 8 and 9 o'clock a. m.

Schedule of Inspection Fees. (Per. Sec. 278, Ordinance 1008)

For each outlet at which current is to be controlled or issued for 4 lights or under	$ .05
For each outlet at which current is to be controlled or issued for over 4 lights	.10
For one arc lamp	.50
For each additional arc lamp	.25
For each motor of 1 h.p. or less	.50
For each motor of more than 1 h.p. and not more than 3 h.p.	1 00
For each motor of more than 3 h.p. and not more than 8 h.p.	1 50
For each motor of more than 8 h.p. and not more than 15 h.p.	2 00
For each motor of more than 15 h.p.	2.50
For each generator of 1 kw. or less	.50
For each generator of more than 1 kw. and not more than 3 kw.	1 00
For each generator of more than 3 kw. and not more than 8 kw.	1.50
For each generator of more than 8 kw. and not more than 15 kw.	2.00
For each generator of more than 15 kw.	2 50

Provided, however, as a minimum, the total amount of any bill of fees to be charged shall not be less than fifty (50) cents.

7. Feed wires for all appliances, such as motors, arc lamps, signs, etc., will be charged for at the rate of 10 cents per circuit and the inspection fee specified in Ordinance 1008 will be collected from the person or company installing the device.

8. All switch outlets where grouped in gangs will be charged at the regular rate, viz: five (5) cents for each switch controlling 4 lights or less and ten (10) cents for each switch controlling more than 4 lights.

9. All single-light outlets, whether in borders, strips or grouped in any manner, except in signs, fixtures or clusters, will be charged a fee at the rate of 5 cents each.

10. For each illuminating outlet on a marquise, a fee of five (5) cents will be charged. When signs are attached or built in the front or sides of same, the usual sign fee will, in addition apply to each sign.

11. For surveys of old electrical installations, a minimum fee of $1.00 will be charged, and where the time expended thereon exceeds one and one-half hour, a fee at the rate of seventy-five (75) cents per hour will apply.

Installation Rules.

12. **Moulding.**—The installation of electrical conductors in wooden moulding will not be approved.

13. **Service Switches**—In all buildings having a basement or tradesmen's entrance from the sidewalk, the main service switch must be installed immediately within the door of said entrance, and not more than 6 feet therefrom. The switch and service cutout must be enclosed in an approved iron cabinet, provided with a glass door upon which shall appear the words "Main Service Switch" in lettering not less than one inch in height.

In buildings not having entrances as described above, the main service switch must be installed in an approved iron cabinet, located at a point immediately within the main entrance of the building, to be designated, in each instance, by the department. The cabinet must be provided with a glass paneled door as described above.

In buildings of the latter class, and where appearance is a feature, the main service switch operated by remote control may be installed at the main switchboard (or if there is no main switchboard at the meter-board), and operated by a flush, push-button switch located in the main entrance as heretofore provided.

The wires from the controlling switch to the service switch must be installed in rigid conduit.

Where the lower floor of a building is occupied by stores, the entrance to the upper stories shall be considered the main entrance.

14. **A.C. and D.C. Systems**—Alternating and direct current systems will not be approved in the same cabinet, except where double-throw switches for the purpose of connecting to either system are enclosed in the same. In this case, the two systems may enter the same cabinet, provided, however, that the wires of each are properly separated in the cobinet and gutter of same. Main switchboards may have separate panels for each system, provided they are properly protected.

15. **Service Wires**, whether connected to overhead or underground systems, must be installed in approved rigid conduit, extending, in the first case, from a point on the outside of the building at least 20 feet above the sidewalk and at that corner of the building nearest the proposed point of connection to the source of current supply, to the main service switch and thence to the motor location.

If current is supplied by an underground system, the service conduit must extend from the point of entrance of supply wires in basement to the main service switch and thence to the meter location. Wires installed under ground must be lead covered and enclosed in rigid iron conduit, the joints of which must be leaded to prevent entrance of moisture.

16. **Feeds and Service Wires** must always be of sufficient size to carry all lighting and power circuits loaded to their full capacity. In the case of lighting circuits, this will mean six amperes to each circuit installed. For two circuits or equivalent, or less, install 2-wire service. For more than two circuits and not more than six circuits or equivalent, install 3-wire convertible service. (Neutral wire of convertible services to be of a carrying capacity equal to the

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[1] Adopted by the Joint Board of Fire and Police Commissioners, December 9, 1910. Effective March 1, 1911.

full load). For more than six circuits, install 3-wire service, either convertible or non-convertible. No service wires smaller than No. 12 B&S gauge will be approved.

17. **Wires in Conduit.**—The use of rigid conduit will be required for:

(a) Feed wires to centers of distribution, motors, signs, reflectors, heating devices, resistance coils, low-voltage transformers or choke-coils.

(b) Wires for exit, entrance, fire-escape, halls, public toilets and baths and lobby lights in public halls or in hotels, apartment or office buildings of over two stories in height.

(c) Service wires.

(d) Wires on exterior of buildings.

(e) Wires to lights outside of buildings where fed from concealed wiring.

(f) Wires in theaters, nickelodeons, etc.

(g) Wires in elevator shafts.

(h) Wires in basements, except where concealed in finished walls or ceilings.

(i) Wires exposed to mechanical injury or flying combustible material.

(j) Wires within 4 feet of belts or pulleys.

(k) Wires in or on marquises.

(l) Wires in damp places, such as stables, breweries, hotel or restaurant kitchens, bath houses, etc.

In the above cases, the conduit must always extend from the lights, motors, etc., to the center of distribution.

Note: Rule 17 is supplementary to City Ordinance 990, which provides that, in the fire limits ALL wires used for conducting electricity (except wires for telephone, telegraph, call-bell or similar systems) shall be enclosed in National Code Conduit or other approved armored conductors.

18. Where devices are permanently located, conduit must extend to terminals and be provided with some form of approved terminal fitting. Conduit to permanently fixed signs or reflectors, either in or on buildings, must enter and be properly connected to metal of same.

19. All ends of conduit where the same does not enter gutters, panels, outlet boxes or plates, must be equipped with approved terminal fittings. Bushings will not be approved except at points mentioned.

20. On the exterior of buildings or in other damp places, the threads of conduit must be filled with lead to prevent the entrance of moisture, and all boxes or conduit fittings must be of approved weather-proof type.

21. Wires in flexible steel-armored conduit or steel-armored cable will not be approved on exterior of buildings or in other damp places, or when in concrete or in channels in concrete or brick walls, unless provided with a lead covering between the wire and the armor.

22. All rigid conduit must be securely fastened every 4 feet, except where laid underground or in concrete or cement. (Where flexible conduit is used for open work, fastenings must be installed at shorter intervals when required.)

23. The use of armored cables for concealed work will not be approved unless installed in such manner as to be readily withdrawn and replaced at any time without damage to walls, ceilings, floors or other portions of building.

24. The installation of more than three No. 14 B&S gauge or more than two Nos. 12 or 10 B&S gauge wires will not be approved in any one-half-inch conduit; nor will more than four Nos. 14 or 12 B&S gauge or more than two Nos. 14 or 12 duplex B&S gauge wires be approved in any three-quarter-inch conduit. Conduit of a size sufficiently large to permit of the easy insertion and withdrawal of other numbers or sizes of wire must be provided. The use of grease, oil or compound of any kind, in the installation of wires in conduit, is prohibited, but the use of soapstone is strongly urged in all cases.

25. Conduit must be fastened into all boxes and gutters with lock nuts. (Bushings must not be depended upon for fastening, their purpose being only to protect the wire from sharp ends of conduit).

26. Wires used for grounding conduit must be of a size and carrying capacity equal to that of the largest conductor of the system and the ends must be soldered into lugs of ground clamps, provides that no ground wire larger than No. 2 B&S gauge will be required.

27. All strips used to provide an efficient bond between conduits entering cabinets or boxes which do not afford good electrical connection, must be installed in interior of box or cabinet and be of copper not less in thickness than No. 20 B&S gauge. Strips must be sufficiently wide to allow for the punching of holes, to admit conduit, without damage to edges.

28. Ground clamps must be so installed as not to be concealed upon the completion of the building and must be connected to water pipes of sufficient size.

29. **Outlet Boxes.**—Approved metal outlet boxes must be installed at all outlets where current is issued or controlled. This applies to all outlets for flush or surface switches, attachment receptacles, fixtures, sockets, cord drops, Nernst or arc lamps.

30. All metal switch and outlet boxes must be fastened to a backing, at least ⅞ of an inch in thickness, with screws, except where firmly embedded in cement or concrete or where iron supports of sufficient thickness are fastened rigidly between studs or joists. In the latter case, bolts and nuts may be used.

31. The ends of all wires at outlets, where fixtures are not installed, must be taped and provided with approved outlet box covers. The company installing the wiring will be held for the taping of ends of wires, and the company installing fixtures, etc., for the installation of covers on unused outlets.

32. Where wires, other than those in conduit, enter outlet boxes, they must be protected with approved flexible tubing, extending in continuous lengths from the last porcelain support or outlet into the outlet box, and must be equipped with some form of metal holder which will prevent the withdrawal of the tubing from the box.

33. Outlets on exterior of buildings fed from concealed wiring must be equipped with approved weatherproof outlet fittings, all wiring connections to be made within the same. The canopies of fixtures must not be depended upon to protect splices of wires from the weather. Where outlet boxes are used, they must be of approved weatherproof type and provided with covers through which stem of fixture must pass, except lights on roofed porches or covered passageways.

34. **Neutral Wire,** Fuse Omission.—In three-wire (not three-phase) systems, the neutral fuse must be omitted, and the neutral wire must be of equal carrying capacity to the larger of the outside wires.

35. **Cut-outs**—Every possible effort must be made to secure distribution centers located in easily accessible places, at which points the cut-outs and switches controlling the several branch circuits shall be grouped. Where more than two branch cut-outs are installed, they must be enclosed in an approved cabinet. This will also apply at meter locations.

36. **Public Lighting**—All lights for halls, entrances, lob-

bies, fire-escapes, exits, public toilets or baths must be run to location of main cut-out on house side of meter and connected ahead of same. The fuses protecting these lights must be located at this point.

37. **Lights per Circuit**—On 110-220-volt systems, no installation of interior wiring will be approved with more than 12 sockets to a circuit, except border and foot-lghts in theatres.

38. **Circuit Wire Protection**—The Department will approve 10-ampere fuses on 110-volt lighting circuits and 6-ampere fuses on 220-volt lighting circuits.

39. **Low-Voltage Wiring**—In **interior** of buildings, the load on any 27-volt circuit must not exceed 12 amperes, and No. 12 wire must be used. On **exterior** of buildings No. 12 wires must be installed for each circuit, and the load must not exceed 15 amperes.

40. **Low-Voltage Fixture Wiring**—No. 16 B&S gauge wire must be installed for 4 lights or less. In fixtures having more than 4 lights, the size of wire shall be No. 14 or larger, as may be determined by the load.

41. **Low-Voltage Transformers**—Must, on **exterior** of buildings, be mounted on a marble, slate or soapstone base not less than one inch in thickness and of sufficient size to extend two inches on all sides of transformer; transformer and base then being enclosed in a weatherproof iron cabinet, painted to prevent rust and having at least three 1-inch holes in the bottom for ventilating purposes and provided with a self-closing door hinged at the top and fastened by a catch at the bottom. All wires must enter cabinet through conduit, and a clearance of 3 inches on all sides and front, top and bottom must be maintained. The transformer, slab and cabinet shall be securely fastened to wall by screws; no part—device, slab or cabinet—being dependent on another for support. Transformers of heavily covered types will be approved without cabinet if installed on frame of sign or on slate base if fastened to building and wires are brought within 3 inches of point of entrance to device in conduit provided with approved terminal fitting.

Must, in **interior** of buildings, be installed in the same manner as upon the exterior except, that they must be located in the basement at some point where there is no probability of combustible material being piled against the device—and with this additonal precaution; that an iron vent pipe of not less than 2 inches in diameter shall extend from within the top of the iron box to some point on the exterior of the building, at least 2 inches from the surface thereof, the end of the vent pipe to be turned so as to prevent the entrance of rain.

42. **Motor Feeds**—Feed wires for direct current motors must be of sufficient capacity to carry a current 25 per cent in excess of the rated full load current in amperes of the motor, and the fuses must be of a size which will protect the wire. The "Wiring Data for A.C. Motors" supplement, as issued by the Board of Fire Underwriters of the Pacific, 1910, is hereby adopted as rules governing the installation of alternating-current motors. All switches installed at motors for starting purposes must be double-throw type and so constructed that in case the switch is left in on the starting side, the circuit will be opened by some approved spring appliance, and must have their starting and running sides plainly marked as such.

43. **Heater Circuits**—Each heating device must be protected by cutouts and controlled by indicating switches. These cut-outs must be placed at the center of distribution and at each outlet. (This arrangement will necessitate running separate pairs of wires from the center of distribution to each outlet, fused at normal capacity of heating device as shown on name-plate. The size, therefore, of these feeds can only be determined if it is known what type of heaters are to be used and the maximum current consumption of the same). A red pilot lamp must be installed at each outlet, fed from the heater circuit and operating from same switch as heater.

44. **Concealed K. & T. Work**—All metal pipes must be considered as current-carriers in concealed knob and tube work, and a 5-inch separation must be maintained between the pipes and wires.

45. **Wires in Attics** more than 2 feet in height must be run between and through ceiling joists, as in concealed work.

46. **In closets** used for the storage of wearing apparel or other combustible material, lamps, whether suspended from ceiling or located on side wall, must be equipped with approved metal guards.

47. **Damp Places**—All lights, fixtures or brackets located within reach of basins, bathtubs, sinks, washtubs or faucets must be provided with keyless weatherproof sockets and be operated by a wall switch.

48. **Receptacles,** where installed in floors must be provided with approved waterproof boxes and fittings.

49. **Pendant Cords** In all cases where portable lamps come within 6 feet of the floor, Rule 28 d, "National Electrical Code," will apply.

50. **Moving Picture Machines**—For advice as to Specifications for Installation and Maintenance, see National Code and supplementary pamphlet. New installations and any alterations or extensions to existing equipment of nickelodeons or other places showing moving pictures must be performed by registered electricians and covered by certificate of inspection before current is connected.

51. **Telephone or Signaling Systems** For provisions regulating installation, see Class "E", National Electrical Code.

52. **Signs** For requirements governing the construction and installation of electric signs, see Ordinance 1009 (new series), Board of Supervisors.

53. **Temporary Lighting**—For temporary decorative lighting, either in or on buildings or over public streets or sidewalks, specifications must be filed and Special Permit secured before installation.

54. **Laboratory Approval**—All material, fittings or devices which do not bear the approval of the Underwriters' Laboratories must be submitted to the Department for investigation and official report before being installed. Also, in the case of all devices, the name or trademark of the manufacturer, and the rating in volts and amperes or other proper units must be so marked thereon as to be readily observed after installation.

References—For information on material and devices that have been examined and tested by the Underwriters' National Eelectric Association, see List of Electrical Fittings, revised semi-annually, and the Laboratory Serial Report Cards, showing results of all tests, on file in the office of the Department. For Construction Rules, containing requirements and details of construction for Fittings, Devices and Materials, see "National Electrical Code," Class "D."

Note: The Rules and Regulations herein published, authorized under the provisions of Section 270 of Ordinance 1008, Board of Supervisors, are **supplementary** to the "National Electrical Code," and become effective March 1, 1911.

On filings submitted prior thereto for installations to be started on or after said date, there must be appended a true and duly executed copy of contract.

WM. H. URMY,

Chief, Department of Electricity, City and County of San Francisco

PACIFIC POWER AND LIGHT COMPANY.

During the coming year the Pacific Power & Light Company will spend approximately $1,500,000 in extending and improving its power and light lines and its gas and water plants throughout the Pacific Northwest. This work will be carried on in territory that is tributary to Portland and will mean a great deal for that city. The company is a sister corporation to the Portland Gas & Coke Company. The Pacific Power & Light Company operates gas, water, electric and street railway plants in such towns as Astoria, The Dalles, Pendleton, Walla Walla, Lewiston, Kennewick, Pasco, Sunnyside and North Yakima, and intends to cover the irrigation situation in the Columbia, Yakima and Walla Walla valleys with a net-work of transmission lines. There is already a heavy irrigation pumping load and by the end of the present year it is hoped to double it. There is a 66,000-volt transmission line extending 150 miles from Naches power house above North Yakima to Walla Walla, the stretch from Pasco to Walla Walla having just been completed at a cost of over $125,000, and also have 50 miles of 22,500-volt line from Walla Walla to Pendleton and 35 miles from its White River plant at Tygh Valley in Wasco County to The Dalles.

The extension of about 70 miles of 66,000-volt line from Kennewick to the Hanford Irrigation & Power Company's power house at Priest Rapids, on the Columbia River, is under way and about 50 miles of 6600-volt distributing system will be extended from the Milwaukee crossing on the Columbia River at Beverly to Hanford, Washington, this completely covering that territory.

In the Yakima Valley the distributing system from the high tension lines at Sunnyside and Toppenish is being extended to such towns as Wapato, Parker, Zellah, Granger and Outlook. In the Walla Walla Valley about 20 miles of high tension and distributing system will be built from Freewater westward toward Touchet, serving a large irrigated district in that vicinity.

Among the important construction work now under way is rebuilding the White River plant south of The Dalles at a cost of $50,000; the building of a new sub-station at Walla Walla at a similar cost; the installation of a 1000 h.p. generator at the Walla Walla River plant, and new sub-stations at Touchet, Toppenish, North Yakima, Richland, Hanford, White Bluffs, Benton City and Beverly. Additional gas benches are to be installed at Pendleton, Walla Walla and North Yakima and about $25,000 worth of large pipe will be laid underground at Walla Walla which will greatly increase the efficiency of the plant at that place. New boilers being added to the Kennewick substation will practically double its capacity.

It has not yet been decided whether the increased capacity at the Dalles will consist of steam or water power. The general offices of the Pacific Power & Light Company are in Portland, where they occupy the twelfth floor of the Spalding building. The Pacific Power & Light Company also controls the Walla Walla Valley Railway Company.

WATER-POWER UTILIZATION IN JAPAN.

The granting of water rights by provincial authorities has been suspended, it being asserted that of the 1,350,000 horsepower concessions already granted many have been secured by parties who intend to speculate in hydroelectric franchises, which is branded as an evil, and the government is now making a systematic examination and survey of the water-power sources of the Empire. There are to be 13 offices established for the collection of this information, and when this is assembled suitable regulations will be promulgated. It is necessary to have careful investigations made, as a great many streams in Japan are dry in summer.

There are a number of hydroelectric power plants already constructed in Japan of comparatively small capacity. The only large plant in operation being the Katsuragawa power plant located about 40 miles from Tokyo, which develops about 20,000 horsepower for use in that city. Another large plant is being developed in the vicinity of Kyoto, and still another very large one is under consideration about 40 or 50 miles from Tokyo, which will be entirely separate from the Tokyo electric light plant.

Some experts assume that there are only a few large projects which can be safely developed with assurance that large units of power could be had—that is to say, upward of 20,000 horsepower plants—but promoters estimate that there are 500,000 horsepower available in the vicinitiy of Tokyo alone, and that Tokyo requires 125,000 horsepower at the present time. Hydroelectric promoters declare that they have confidence in their ability to locate power plants throughout the country that will total between 1,000,000 and 2,000,000 horsepower.

From an industrial standpoint this problem of developing cheap hydroelectric power in Japan is of great importance. Coupled with cheap labor, electric power may enable Japan to become a competitor with other countries in numerous lines during the next ten years.

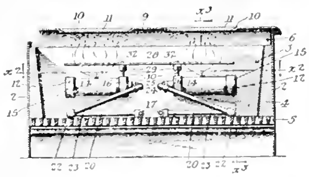
Japan possesses an unusually large number of available streams suitable for hydroelectric power enterprises, and the assembling of its operatives in factories and mills (instead of confining their efforts mostly to home industries) will be felt in the output of their organized productive capacity far outside the Empire.

The demand for electrical machinery in Japan is increasing, and plants for its promotion are being built within the Empire by Japanese and foreign capital combined.

The government has taken into consideration the fact that Japan's coal consumption has approximately doubled during the past 10 years, largely from demands for power used in manufacturing enterprises, and it is assumed that this steadily increasing demand for power plants may be expected to greatly increase the cost of coal, to meet which the authorities look to the anticipated rapid development of cheap water-power facilities, and they estimate that from a possible 1000 localities in Japan suitable for such purposes approximately 1,000,000 horsepower may be utilized.

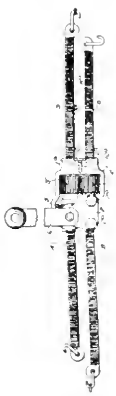
PATENTS

981,083. Oil-Burner. Henry J. Hennings, San Gabriel, Cal. An oil burner comprising a pair of tubular superheaters arranged in alinement in the same horizontal plane, each of said superheaters having an outlet in the upper side thereof, an oil supply pipe, oil inlet pipes connecting said oil supply pipe to the superheaters, means for regulating the flow of oil



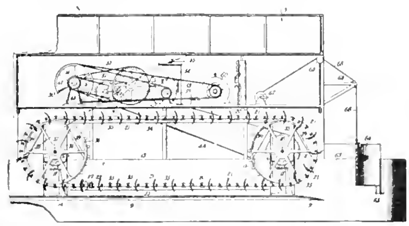
through the oil inlet pipes, one of the oil inlet pipes for each superheater being diagonally disposed and forming vertically adjustable support for the superheater, a standard on each superheater, and a spreader plate above said superheaters mounted on the standards and provided with a series of perforations in the spreader plate to receive each standard.

981,126. Wire-Stretcher. George Scroggie, San Diego, Cal. In a wire stretcher the combination of a casing, two threaded rods mounted therein, hook members mounted on said screw rods, detachable means for preventing said rods from turning in said case, internally threaded spur and bevel-



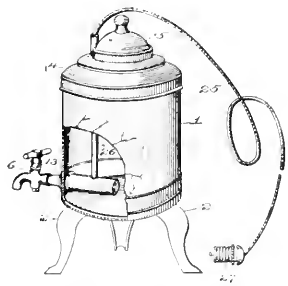
gear means adapted for operating said rods in opposite directions, another bevel-gear in engagement with the aforementioned bevel-gear, a crank for operating said latter mentioned bevel-gear, and a detachable piece on said case, all substantially as set forth.

981,514. Water Motor. Rufus Ames, Spokane, Wash., assignor to American Power & Light Company, Spokane, Wash. A water motor comprising a floated housing arranged to form internal water ways; a plurality of sprocket wheels separated and mounted on suitable driving shafts; endless link chains rotatively connecting said wheels; a plurality of concave blades pivotally mounted on said chains to extend into said water ways; mountings for said blades embodying a plurality of link members pivoted each to the other and limited in their swing by an interposed member, said links being connected one to the said blades and one to the said chains; suitable generating mechanisms mounted in said housing; and



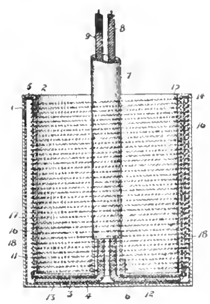
transmission devices connecting said motor and said generating mechanisms.

981,481. Electric Heater. Milton H. Shoenberg, San Francisco, Cal., assignor to Presto Electrical Manufacturing Company, San Francisco. An apparatus for heating liquids



comprising a receptacle, a faucet connected thereto, and an electric heater having a tubular passage extending therethrough said passage forming a direct continuation of the faucet passage.

981,244. Electric Water-Heater. Herbert A. Burns, Oakland, Cal., assignor to Diamond Electric Water Heater Co., San Francisco, Cal. An electric water heater comprising a cup-shaped member having inner and outer cylindrical cas-



ings, a coil of high resistance wire between said casings, suitable insulation therefor, a tube secured to the inner casing, and conducting wires extending within said tube and connected to said high resistance wire, substantially as described.

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DIRECTORS

R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Competition

Competition was, is and ever shall be. Though this word came into our language long after the time of Shakespeare, its spirit has governed man's action from time immemorial. What is all business but organized commercial competition? Every monopoly is founded upon competition, and the competition, being perennial, will spring up as often as circumstances foster it. The giant sloths and mastodons which flourished in the Tertiary period are now extinct because they could not compete with recent conditions. The present state of business warrants the existence of great trusts while the future situation may demand some other mode of business. Public utility corporations which have absorbed private competitors are always liable to governmental competition which has already assumed the form of rate regulation.

In its abstract sense of emulation competition is a good thing in promoting progress, but in its concrete meaning as rivalry it hinders development. Competition is often friendly but rivalry is frequently hostile, especially where a competitor is regarded as an opponent to be defeated by fair means or foul. Such means as price-cutting, "knocking" and even more vindictive methods of injuring a competitor bring profit to none and disaster to many. They demoralize trade almost as much as do the foolish actions of those who have had no experience in the business in which they are embarking or who do not use ordinary intelligence in conducting their business. It should never be forgotten that though high prices kill trade, low prices kill profit.

The ways of beneficial competition are many. Perhaps first is the matter of quality. It is axiomatic that at the same price the superior article appeals to the buyer, improved quality of output bringing corresponding increase in volume of sales. Prompt delivery is another matter in which there is great chance for improvement, especially on the Pacific Coast. Furthermore, business ethics demands honesty as the price of confidence, while dishonest dealings ultimately enforce their own penalty.

Competition, like criticism, can be constructive as well as destructive. Co-operation among competitors is the best means of building up any industry. The terms co-operator and competitor are not necessarily antonyms, though they are mathematical reciprocals, nor is the co-operator always the under dog. The ordinary channels of business between maker and user may aptly be compared to a power system wherein the commodity is transmitted in large quantities at low prices to the jobber, whence it is distributed in smaller quantities at higher prices to the retailer. Letting quantities represent volts, prices amperes, competition impedance and co-operation capacity, our business equation is analygous to that for alternating current circuits, the price is equal to the quotient of the quantity and the square root of the sum of the competition and the co-operation.

PERSONALS.

F. G. Baum is at Reno, Nevada.

C. L. Cory has returned to San Francisco from an extended trip to Los Angeles.

W. M. Papst, a director in the Portland Gas & Electric Company, arrived at San Francisco last week.

Arnold Pfau, hydraulic engineer of the Allis-Chalmers Company, is at San Francisco from Milwaukee, Wis.

L. A. Osborne, second vice-president Westinghouse Electric and Manufacturing Company, is at San Francisco.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company of Chicago is at Los Angeles.

D. C. Richardson, the auditor of the Western Electric Company, has been at the San Francisco branch of the company.

A. C. Balch, general manager of the Pacific Light & Power Company of Los Angeles, was at San Francisco, this week.

Geo. A. Kyle has resigned as vice-president of the Oregon Electric Railway of Portland to resume his engineering practice in that city.

Roy Wolden, general manager of the San Francisco branch of the California Electrical Construction Company is visiting New York City.

E. N. Sanderson, senior member of the firm of Sanderson & Porter, is inspecting his company's recent work in the Pacific Northwest.

M. W. Cornitius has been appointed a district superintendent of equipment of the Pacific Telephone & Telegraph Company with headquarters at Los Angeles.

H. P. Wilson, a New York financier who was prominently connected with the financing of the Great Western Power Company, arrived at San Francisco the past week.

Richard M. Vaughan, formerly engineer and district manager of the Portland office of Kilbourne & Clark Co., is now engineer for Caldwell Bros. Co. of Seattle, Wash.

John C. Stevens has resigned as district engineer with the U. S. Geological Survey and has opened offices as civil and hydraulic engineer in the Spaulding Building, Portland.

Edward L. Elliott, formerly with the Wenatchee Electric Company at Wenatchee, Wash., is now in the engineering offices of the Pacific Power & Light Co. at Portland, Ore.

Eldon F. Beal is superintendent and J. O. Farnsworth operating engineer of the Central Oakland Light & Power Company, which started up its steam power electric plant in Oakland last week.

W. H. Whiteside has resigned as president of the Allis-Chalmers Co. of Milwaukee, Wis., being succeeded by D. W. Call, formerly assistant to W. V. Kelley, president of the American Steel Foundries Company.

A. G. Jones, sales engineer with the General Electric Company, has been appointed secretary of the San Francisco Section of the American Institute of Electrical Engineers, succeeding Edward L. Haines, who has been forced to relinquish these duties because of illness.

C. E. Fleager, formerly district superintendent of plant of the coast district of the central division of the Pacific Telephone & Telegraph Co., has been appointed division plant engineer with headquarters at San Francisco. E. H. Long has been appointed to succeed him in the former position.

C. F. Elwell, who represents the Poulsen Wireless Telegraph & Telephone Company in America, is again at his San Francisco office after spending some time in Europe. Messages are being received daily at their San Francisco wireless station direct from their Los Angeles station and also by relay from El Paso, Texas.

O. C. Pratt, who was recently re-elected president of the Indian Valley Electric Light & Power Company, announces that at a recent meeting of the stockholders at Quincy it was decided to remove the principal office of the company from that place to 1108 Crocker Building, San Francisco. Extensions of the system in Plumas county are in the plans.

K. Kishi, chief electrical engineer of the Shibaura Engineering Works in Japan, and S. Momota, who have been spending several months in the Eastern States investigating American methods of electrical manufacturing, sailed last Wednesday on the "Tenyo Maru" from San Francisco for Japan, after inspecting high tension electric power installations in this part of the country.

Newly elected associates of the American Institute of Electrical Engineers include: J. L. Blaisdell, engineer, Portland Railway, Light and Power Company, Portland, Oregon; L. W. Collins, city electrician, light and water department, Tacoma, Wash.; W. G. Crawford, sub-station operator, Seattle-Tacoma Power Company, Seattle, Wash.; Carl Irving, electrician, Los Angeles Aqueduct, Los Angeles, Cal.; W. C. Johnson, salesman, Westinghouse Electric and Manufacturing Company, San Francisco; Geo. L. Perrin, electrician in charge Montgomery-Shoshone Mining Company, Rhyolite, Nevada; F. A. Phipps, draughtsman, Seattle Electric Company, Georgetown, Wash.; R. B. Rathbun, chief electrician, Balaklala Consolidated Copper Company, Coram, Cal.; J. G. Woodward, switchboard operator, Pacific Light and Power Corporation, Redondo, Cal.

TRADE NOTES.

The San Joaquin Light & Power Company recently purchased from the Allis-Chalmers Company 26 transformers for use in connection with their 60,000-volt transmission lines in the San Joaquin Valley.

The British Columbia Electric Railway Company of Vancouver, B. C., have awarded a contract for two 60,000 volt electrically operated automatic oil switches of the outdoor type, to be furnished complete with steel towers, to the Kelman Electric & Manufacturing Company of Los Angeles, through Pierson, Roeding & Co., their Pacific Coast representatives.

The Dearborn Drug and Chemical Works, who have distributed their feed water treatment and lubricants through an agency in the Philippines for the past two years, have decided to open their own branch office and warehouse in Manila, and F. O. Smolt, who has been connected with mining propositions since his graduation in chemistry from the University of Illinois in the class of '91, has become connected with the Dearborn Company and sailed on January 7th for Manila, to take charge of this work, under the supervision of E. C. Brown, manager of the foreign department of the Dearborn Company. Mr. Brown has spent most of the past two years in Japan, China and the Philippines, investigating steam plant and railroad conditions in the interests of Dearborn products and is still there, having made selling connections at Tokyo, Tientsin, Hongkong and Shanghai.

PACIFIC COAST MEETING, A. I. E. E., AT LOS ANGELES.

The Board of Directors of the American Institute of Electrical Engineers has authorized a special institute meeting on the Pacific Coast, to be held in Los Angeles during the month of April, under the auspices of the Telegraphy and Telephony, Railway and High Tension Transmission committees. A local committee appointed by the President will fix the exact dates and make arrangements for the meeting.

INDUSTRIAL

WESTINGHOUSE D.C. WATTHOUR METER.

The direct current watthour meters made by the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., are designed with the same attention to detail and thorough investigation and study displayed in the well-known type C alternating current meters manufactured by the same company.

The meters are of the commutator type and depend on the same principle of operation as a.c. similar meters. High accuracy over a wide range and permanence of calibration over long periods are attained, by the careful design of the details affecting permanence and accuracy. Accuracy is attained by providing a high torque and low friction and by avoiding entirely the use of iron, the varying permeability of which introduces error at some point in the meter's range. Permanence is attained by providing jewel bearings having long life and protecting the permanent magnets as far as possible from the stray fields produced at overloads.

Fig. 1.

The full load torque of the Westinghouse meter is approximately 150 millimeter-grams. This high torque is not obtained at the expense of power consumed in the meter, as the loss in the potential circuit is only 4 watts per 100 volt rating, and the current circuit of a 200 volt meter produces a drop only 0.5 per cent at full load. The high torque is a result of careful design of the windings and their position. Reference to Fig. 1 shows the compact arrangement. The armature consists of a hollow, corrugated sphere of paper wound with special silk covered wire. This gives an extremely light but remarkably strong construction and permits the use of a circular field winding, a shape requiring the minimum amount of wire and therefore having the minimum resistance for a definite number of turns. The weight of the complete moving element is 35 or 90 grams. The ratio of torque to weight is therefore 1 7.

The commutator is made very small in diameter to minimize friction. Uniform brush friction at all degrees of wear is obtained by making the brush tension depend entirely on gravity. Each brush consists of two round wires, held against the commutator by means of adjustable counterweights as shown in Fig. 2. Brushes and commutator are of non-oxidizable material. Therefore neither the brush friction nor the contact resistance is subject to change and no inaccuracy is introduced.

An important feature of these meters, in its relation to low friction and permanence, is the construction of the main bearing. The usual form of jewel and pivot bearing has been entirely discarded in Westinghouse watthour meters. Instead is used a highly polished and separately hardened steel ball working between two sapphire cup jewels. The shaft, owing to the fact that the centre of gravity of the moving element cannot be made to coincide exactly with the centre of rotation, has a slightly eccentric motion which gives the ball a rolling action. This not only introduces less friction than the usual boring action but, by presenting constantly new bearing surface minimizes wear.

The position of the permanent retarding magnets in relation to the meter coils is an important feature. It is obviously impossible to shield the magnets from the coils as is done in alternating current meters, because an iron shield would soon become polarized and introduce errors. In these meters the permanent magnets and disc are placed at the top of the mechanism, as far as possible from the coils. As a result of this the accuracy is practically unaffected by overloads.

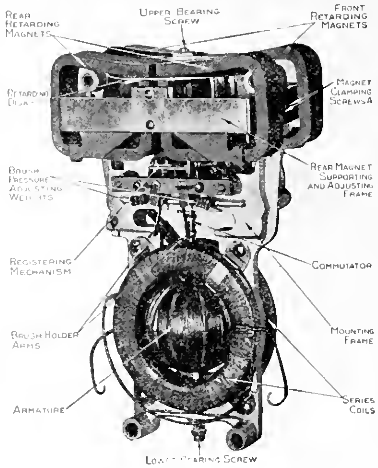


Fig. 2.

The positive full load adjustment is also worthy of note. Each pair of permanent magnets is mounted on a heavy brass U-strap, the ends of which slide in machined grooves in the supporting frame. It is therefore impossible to twist the magnets out of alignment in tightening the adjusting screws. Each end of the magnet support is clamped, when adjusted, by means of two screws to insure a firm clamping action. The light load adjustment can be made very accurately by means of the coil C shown in the illustration.

All parts of the meter are mounted on a central frame insulated from the meter case. This construction makes it possible to remove and replace the meter element as a unit without in any way disturbing the adjustments.

The case is of cast aluminum of strong mechanical design, having dust-proof arrangement for the entrance of leads. The cover is pressed of a single sheet of aluminum plate. It is fitted to the case with a dust-proof gasket and held by two wing nuts which can be conveniently sealed.

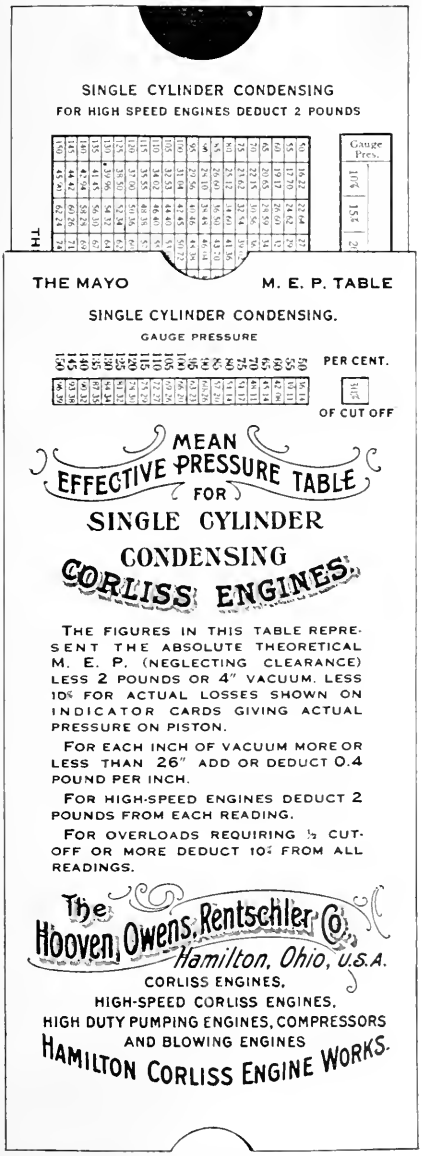
The meters guaranteed to register within two per cent, or throughout the entire range from 10 per cent of full load to 50 per cent overload, which overload can be carried continuously.

These meters are fully described in the Westinghouse publication No. 1137, which also gives an interesting description of the principles on which watthour meters, both a.c. and d.c. operate.

MAYO MEAN EFFECTIVE PRESSURE TABLES.

The calculation of the mean effective pressure of Corliss engines, both single cylinder and compound, operating under condensing and non-condensing service, has always been a tedious mechanical process. While any one may calculate this mean effective pressure by means of standard formulas, engineers have usually avoided this work with the result that the figures have never become thoroughly standardized. It often happens at a contract-letting where from eight to ten engine-builders are represented, that each builder offers an engine of a different size, which is not only inconvenient for the engine-builder, but results in delays and confusion to the purchaser as well.

The Hooven, Owens, Rentschler Company of Hamilton, Ohio, builders of Hamilton-Corliss engines, high-duty pumping engines, compressors, blowing engines, etc., have recently issued two tables neatly gotten up with celluloid covers, by means of which the mean effective pressures for the different types of Corliss engines, and therefore their horsepower can easily be obtained. The object of thes folders was to get some uniformity in ratings amongst engine-builders. They will be found of much interest to engineers and others connected with the generation of steam power by reciprocating engines.



Each set of tables consists of a celluloid casing with a transverse slot near the end, at the side of which the various gauge pressures are printed. Within this casing is a scale upon which the number of expanions or points of cut-off are marked, together with a table of mean effective pressures. It is readily seen that by sliding the scale until the desired number of expansions or percentage of stroke at cutoff is immediately under the opening provided for it, there will be found adjacent to the steam pressure the correct value for the mean effective pressure.

One table gives the results for single cylinder engines, both condensing and non-condensing; the other for compound condensing and non-condensing engines. For condensing operation a vacuum of 26 in. is assumed, but a constant is given which can be added or deducted for variations from this vacuum. Gauge pressures of from 50 to 200 lb. are tabulated. The compound engine table shows results of any number of expansions between 5 and 27.

To illustrate this matter more clearly, let it be desired to obtain the mean effective pressure for a single cylinder condensing engine operating with a gauge pressure of 125 lb., a vacuum of 25 in. and a point of cut-off of 30 per cent. The illustration herewith shows one of these folders adjusted so as to obtain the desired figure. From this illustration it will be readily seen that the mean effective pressure required will be found opposite the gauge pressure of 125 lb. In this instance the figure is 81.32. This, however, is based upon a vacuum of 26 in. Deducting a constant of 4 lb. per inch vacuum the desired figure will be 80.92 lb.

These tables will be furnished to anyone interested by applying either to the Hooven, Owens, Rentschler Company, Hamilton, Ohio, or Chas. C. Moore & Co., engineers, San Francisco, their Pacific Coast representatives.

THE WESTERN ELECTRIC COMPANY'S YEAR.

The Western Electric Company has this year changed its fiscal year to end December 31st, instead of November 30th. For the thirteen months ending December 31, 1910, its sales will be approximately $66,000,000 as compared with $45,000,000 for the twelve months of last year. These sales for 1910 compare with $69,000,000 for the year 1906, which was the largest year in the history of the company.

The increase over the past year has been well distributed over the various lines of merchandise which the company handles, such as telephones, cables, motors, generators and electric light supplies, and the increase in the business has been well distributed throughout the United States.

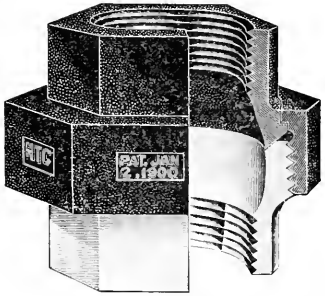
The Western Electric Company has approximately twenty houses throughout the United States, through which it distributes its electric manufactures and supplies. The company during the past year has continued its policy of concentrating the manufacturing at Hawthorne, and several millions of dollars have been spent there in new buildings.

The latter part of 1910 more new buildings, to cost $1,000,000, have been authorized, which will still further increase the capacity of the plant. The company now employs altogether upwards of 24,000 men.

THE KEWANEE UNION.

The "Kewanee" union, illustrated herewith, has been on the market for a number of years, and was the result of a desire to meet an increasing demand for a union which could be readily disconnected at varying intervals of service. Numerous types of unions had been made, but for the most part the all-brass union seemed the best solution for a non-corrosive thread connection. But the all-brass union did not fully answer the problem, and it was not until the advantages of the "Kewanee" principle were fully worked out, and became a practical fitting, that the troubles of the mechanical man, due to leaky gasket unions, were finally reduced to the vanishing point.

The unique advantages of the "Kewanee" union include brass to iron thread connection, brass to iron ball joint seat, only three solid parts and compressed air test under water.



The brass to iron thread connection prevents corrosion, and allows the union to be disconnected and reconnected almost indefinitely, and without injuring the union. There are instances on record where unions have made tight joints after a thousand disconnections. The thread connection can be easily moved with a common wrench even after long service.

The brass to iron ball joint seat makes an air tight seal without a gasket. Wherever a gasket is used, the possibility of trouble is never very far away, and it is frequently at the most inopportune times that a gasket blows out. A gasket may be good, but to have an air tight joint without a gasket is surely better and best.

The "Kewanee" union is the only gasketless union made up of only three solid parts; that is a bottom of high grade malleable iron; a heavy ring of the same material, and thread end of solid high grade brass. There are only these three parts; there are no rings or inserted pieces of brass to loosen or drop out under pressure.

Before leaving the factory, each individual "Kewanee" union is tested with 100 lb. compressed air while the union is immersed in water. In fact, every union is doubly tested. First the iron bottom is tested; then the three parts are put together and tested. A bubble forms on the surface of the water if there is the slightest leak, and any defective union is scrapped.

TRADE NOTES.

The Anderson Carriage Company of Detroit, Mich., manufacturers of the Detroit electric vehicle, has changed its name to the Anderson Electric Car Company.

The Robb Engineering Company of South Framingham, Mass., announce that they have purchased the Robb-Mumford Boiler Works at the same place. The management and manufacturing organization will be continued as at present.

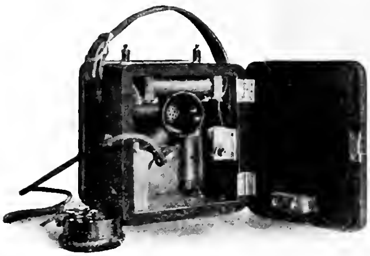
The Curtis vertical turbine that has just been installed under the supervision of J. G. White & Co., at Station "A" of the San Francisco Gas & Electric Company, was placed in commercial operation last Monday. It is rated at 12,000 kw. or 15,000 k.v.a. (80 per cent power factor).

NEW PORTABLE RAILWAY TELEPHONE.

The most compact, and the lightest portable set used in railway telephone dispatching is the No. 2731 Kellogg portable telephone manufactured and sold by the Kellogg Switchboard & Manufacturing Co. This compact little phone weighs

Exterior of Kellogg Portable Railway Telephone.

but 6 lb. 5 oz. The height is 6 and 13/16 in. The width 6¼ in., depth 6 in. The containing cabinet is strongly built with heavy hinged cover.. The accompanying illustrations shows the extreme compactness of arrangement of transmitter, receiver, batteries and the induction coil. The telephone is



Interior of Kellogg Portable Railway Telephone.

used by train men, signal men, officials and line men for talking to dispatchers' headquarters, and is arranged to connect at any point on the circuit. The shape of this telephone box and the adjustable leather strap handle make it handy to carry.

RECTIFIERS CHARGING BATTERIES OF FIRE ALARM SYSTEM.

A mercury arc rectifier has been installed for charging the storage batteries which operate the fire alarm system of the city of Sandusky, Ohio. The battery consists of 4 sets of 15 cells each, Chloride accumulator, Type CT, and, with the present system, fifty fire alarm boxes can be pulled at once.

Previous to the installation of the rectifier, a gravity battery, consisting of 108 cells, operated the fire alarm system. The new installation effects a saving of $300 per year as the expense of cell renewals when gravity batteries were used was a large item of expense. The first cost of the new equipment, including rectifier, battery and distributing board installed complete, was $589, while the cost of power for its operation is about $1.40 per month at a 10c per kw. hour rate. This equipment is operating satisfactorily and during the six months that it has been in operation absolutely no trouble of any kind has been experienced with it. The rectifier panel was furnished by the General Electric Company, Schenectady, N. Y.

NEWS NOTES

FINANCIAL.

SANTA ANA, CAL.—The voters of Santa Ana are to be asked to vote $35,000 bonds for the betterment of the municipal water-works system.

McMINNVILLE, ORE.—The City Council has instructed the city attorney to draft an amendment providing for a bond issue of $30,000 to take up the floating indebtedness of the water and light commission and provide for the extension of the system.

INCORPORATIONS.

HELENA, MONT.—The Treasure State Telephone Company of Broadview, Mont., capital $25,000, has been incorporated by H. W. Bangert, A. Bouchard and E. S. Kingman.

PORTLAND, ORE.—The Northwestern Electric Company has been incorporated by B. De Yarmon, B. C. Condit, C. Wood, H. H. Parker and E. Wood, with a capital stock of $5,000,000.

CHEHALIS, WASH.—The Chehalis & Cowlitz Railroad Company has been incorporated for $300,000 by H. C. Coffman and George A. Robinson to build an electric road from this city to a point on the Cowlitz river near the Plamondon donation claim on the Cowlitz prairie, 20 miles southeast.

ILLUMINATION.

ALBANY, ORE.—P. J. Roive has been granted a franchise for a gas plant to be erected here this year.

ORLAND, CAL.—C. R. Wickes has been granted a franchise in the town of Orland to erect and string wires to conduct electricity for commercial purposes.

HOQUIAM, WASH.—The Grays Harbor Railway & Light Company has been granted a contract to furnish the residence district of this city with 80-candlepower tungsten incandescent lights.

LOS ANGELES, CAL.—The City Council has passed an ordinance for appliances to be installed and electric current to be furnished for one year for lighting Sixth street from Main to Alameda street.

LOS ANGELES, CAL.—Dissolution of the Pasadena Gas Company is asked in a petition filed in the Superior Court. All claims against the corporation have been satisfied according to the petition. The directors of the company are: W. B. Cline, Wm. M. Van Dyke, Wm. Baurhyte, Wm. A. Cheney, W. E. Houghton, A. B. Day and H. L. Flash.

RED BLUFF, CAL.—The suit brought by J. A. Long & Sons against the Northern California Power Company, consolidated to restrain that company from completing a ditch across their lands, has been dismissed and an agreement filed by which a right of way 50 ft. wide is allowed for the ditch and 25 ft. for pole line for power, light and telephone purposes.

WALLA WALLA, WASH.—The construction of a 6000-volt distribution line that will tap 28 square miles in the Freewater territory and furnish pumping power for 61 growers from its very beginning has commenced, according to an official announcement made by W. Foshay, local manager of the Pacific Power & Light Company. The line will run from the Freewater sub-station and will extend to within two miles of Gardena, covering a territory of 3½ miles wide and 8 miles long.

SAN BERNARDINO, CAL.—E. H. Rose of Los Angeles, has purchased the property of the Needles Light & Power Company, at this place. The plant is to be improved at once, the present plant being duplicated and the gas plant is to operated in connection with the plant.

ABERDEEN, WASH.—E. C. Miller has made application to the City Council for a franchise for a new electric lighting and power company in this city. The company is to be known as the Citizens Lighting & Power Company, backed by local capitalists, and has secured a lease on the power plant of the Anderson and Middleton mill and is ready to begin operations as soon as the franchise is passed.

PORTLAND, ORE.—Election of officers was held at Vancouver, Wash., by the Washington & Oregon corporation, holding company of the water, gas and street car properties of Hood River, Hillsboro, Forest Grove and Vancouver. The water and light plants at Kelso, Wash., and Rainier, Ore., will be added to the corporation's holdings, options having been secured on them. The officers elected are I. Anderson of Tacoma, president; O. Sinkler, vice-president; C. Heler, secretary; I. Anderson, A. Welsh, E. Hall, board of directors. This corporation acquired ownership of the Vancouver, Wash., street car system a short while ago, including the new electric line operating between Vancouver and Orchards. The line will be extended.

EUREKA, CAL.—A damage suit has been instituted in Humboldt County by the Western States Gas & Electric Company, successors to the North Mountain Power Company, and the Humboldt Gas & Electric Company, against the Fortuna Lighting Company, of Fortuna. The action is to cancel the contract entered into between the North Mountain Power Company and the Fortuna Lighting Company for furnishing current for 30 years and for $20,000 damages. It is alleged that the contract has been forfeited by the actions of the Fortuna company in not living up to agreements, among which was to build up and popularize the lighting and power business in the district allotted to it in the Eel River Valley. It is also alleged that, instead of extending its field of business it has farmed out rights in the territory and has injured the light and power business generally.

TRANSMISSION.

KLAMATH FALLS, ORE.—A. C. Hough, representing the Siskiyou Electric Company, has appeared before the council asking for a 50-year franchise for an electric light and power line here.

WALLA WALLA, WASH.—It is reported that the Pacific Power & Light Company, contemplates extending its service to Dayton from this place and possibly to Turner, ten miles beyond Dayton. The company may buy the plant at Dayton.

TACOMA, WASH.—The Pierce County Commissioners will hold a hearing January 26 on the application of the City of Tacoma for a franchise to construct a pole and transmission line along county roads between the new Nisqually hydroelectric plant and the city limits.

VANCOUVER, B. C.—The B. C. Hydraulic Power Co., Ltd., Vancouver, is making application under the Water Act for a water record of 300 cubic feet per second, to be taken from Nanaimo river and lakes on Vancouver Island at a dam 30 feet high, about 1200 feet above Nanaimo falls, and raising the water level to a point 3500 feet above the point of diversion.

KENNEWICK, WASH.—The Pacific Power & Light Company has assembled over 800 miles of aluminum wire weighing 150 tons here, for the Hanford-Richmond-Kennewick transmission line. This is part of the $250,000 worth of material for that extension.

SEATTLE, WASH.—The Board of County Commissioners of Jefferson County has granted a fifty-year franchise for a power transmission line to the Olympia Power Co., which is to develop 6000 horsepower from the Elwha River. T. T. Aldwell is vice-president and manager of the company.

TRUCKEE, CAL.—J. B. Lukes, local representative of the Stone & Webster Company, which has the managing control of the Reno Power, Light & Water Company, the Truckee River General Electric Company and other common interests in Nevada and California, says that the work of building another power plant on the Truckee river will soon commence.

TACOMA, WASH.—Bills will be received at the office of the Commissioner of Light and Water, City Hall, Tacoma, Wash., on February 6, 1911, for a general contract for furnishing and delivering all material machinery and equipment for the completion of the Nisqually power plant; first section to consist of the building of a 200 foot steel arch span, and two 80-foot approach spans and 10-foot riveted steel pipe, across the Nisqually canyon at La Grande, Wash; second section to comprise conduit and reservoir to cost $292,675; third section to comprise the building of four riveted steel pressure pipes, cost $116,696; section 4, power house, $149,875; fifth section, water wheels and generators, cost $183,185; sixth section, electrical equipment for power house, $89,423; seventh section, electrical equipment for Tacoma sub-station, cost $107,690; eighth section, transmission line about eighty miles long from the power house at La Grande to the sub-station at Tacoma. The general contractor will be required to give a bond in a sum of 50 per cent of the contract price. Plans to be obtained from N. Lawson, commissioner.

TRANSPORTATION.

SUISUN, CAL.—The new electric road, known as the Oakland and Antioch Railway will be completed to Concord and Walnut Creek by February 1.

PHOENIX, ARIZ.—Superintendent S. H. Mitchell is in Glendale making preparations for starting work at that end of the proposed Phoenix-Glendale electric line.

HAYWARDS, CAL.—The town trustees have advertised the application of Isaac B. Parsons for a 30-year franchise for an electric street railway through the town, beginning near the Western Pacific depot and extending to the northeasterly limits.

LOS ANGELES, CAL.—Although $40,000 has been raised for the extension of the Pacific Electric from Glendale to Burbank and stakes for line have already been set, Burbank has been unable to secure the necessary right of way for the line and proceedings are at a standstill.

STOCKTON, CAL.—Morris L. Brackett, vice-president and manager of the San Joaquin Valley Electric Railway Company, which is building an interurban line between Stockton and Modesto has filed an application for a franchise along McKinley avenue, from Stockton to French Camp.

SAN JOSE, CAL.—At a special meeting the city council passed a resolution over the veto of Mayor Davison, declaring the franchises held by L. E. Hanchett for a railway on Santa Clara street, null and void, and called on the Attorney-General to take steps looking to the banishment of the road from local railroad competition. A fight has arisen between mayor and council, first over the lowering of the company's track to a new official street grade, and second over the proposal of the company not to use a grooved rail in Santa Clara street, where the street is paved with bitumen.

PORTERVILLE, CAL.—F. U. Nofziger, manager and trustee of the Porterville Northeastern road, has returned from Los Angeles, where, after conference with the board of directors of the road, the contract for the remaining portion of the railroad was let, and says that the formal ceremonies incident to opening up the hill trade to Porterville will be held on June 1.

STOCKTON, CAL.—A new timetable of the California Traction Company has gone into effect. Two more trains have been added between here and Sacramento. One is called the Lodi express and will run via Lodi without change of cars at Lodi Junction. The new schedule gives a daily service of eight fast trains to Sacramento. This makes 48 interurban trains on this line in and out of Stockton every day.

WATSONVILLE, CAL.—Capitalists are investigating the feasibility of the rehabilitation of the Watsonville Electric Transportation Company which formerly operated a line between this city and Port Watsonville, with the view of extending the line farther back into the valley. Efforts also are being made to secure an appropriation from the legislature for building a detached breakwater, costing $60,000, at Port Watsonville.

TUCSON, ARIZ.—Property owners in the district north and east of the present terminus of Stone avenue are taking active steps for the construction of a suburban street car line at a cost of about $15,000. The building of the line will be taken up with E. N. Sanderson, an official of the New York holding company, which has taken over the Tucson Gas, Electric Light & Power Company, including the Tucson Rapid Transit Company.

SAN FRANCISCO, CAL.—Six recommendations from the Board of Public Works for the setting aside of bond issue funds to cover the cost of material for the Geary street municipal railway in addition to rails already purchased, have been placed before the supervisors. For the heavy copper wire connecting rail ends $5000 is asked; for rail joints and fastenings, $18,000; for redwood cross-ties $17,000; for tubular steel trolley poles, $17,000; for steel tie rods and nuts, $3000; for copper wire, $8000.

VANCOUVER, WASH.—A transfer of property valued at $1,000,000 has been made here. It includes the property of the Vancouver Waterworks Co., Vancouver Traction Co., and the Vancouver Gas Co. The three concerns have been bought and are being taken over by the Oregon-Washington Corporation formed in Vancouver on December 9, 1910, with a capital stock of $5,000,000. It is generally understood that B. M. Atkins, present manager for the Vancouver Traction Co., will have general supervision over all of the Vancouver holdings of the corporation.

SAN FRANCISCO, CAL.—The suggestion has been made and agreed to by the members of the Supervisors' public utilities committee, the Public Works' Commissioners, and the city engineer, that the plans heretofore considered be so modified as to provide for a loop near the western end of the line, to the end that only one track need be laid on that part of Geary street, beyond Thirty-third avenue. Under this plan it is though that the courts would not sustain the United Railroads Company in its pending endeavor to prevent, through injunction proceedings, the city's getting on the street at all beyond Thirty-third avenue. As the street is wide there will be ample room, it is contended, for another track besides

the two of the United Railroads Company, and it was agreed that the city attorney should be asked to make an immediate endeavor to secure such a modification as will allow the city to put down the single track proposed.

SAN FRANCISCO, CAL.—A bill to give San Francisco the right to build and operate a municipal street railway all around the waterfront over the State property is being drafted at the request of the Supervisors' public utilities committee, and will be presented to the Legislature. The purpose is to give the city permission to use the entire embarcadero, better known as East street, with a view to extending the road southward to the county line if advisable. It would be a passenger belt railroad, and give the city command, at the commencement of its municipal developing system, of the shipping frontage. Access to the mail docks and all the chief sailing points would be thereby secured to the municipal lines gridironing the town.

WATER-WORKS.

PORTLAND, ORE.—The city authorities will open bids on January 10th for about 6000 tons of cast iron water pipe.

LEAVENWORTH, WASH.—Leavenworth is preparing for the construction of a new $40,000 water system to be completed this year.

BISBEE, ARIZ.—The Bisbee-Naco Water Company is soon to enlarge its water storage capacity. A steel tank to hold between 500,000 and 750,000 gallons will be built.

MEDFORD, ORE.—The Council has passed resolutions providing for the construction of 4-inch water mains on portions of Oak street, Sherman street and Geneva avenue.

EL MONTE, CAL.—A movement is on foot to form a company of citizens of El Monte to purchase the water system there from J. D. C. Cleminson and improve and enlarge it so as to more fully cover the territory.

LORDSBURG, CAL.—The Board of Trustees of Lordsburg, Cal., will receive sealed bids up to 8 p. m., January 19, for furnishing all material and labor required to construct a municipal water-works system for the city.

HOLTVILLE, CAL.—The City Trustees have awarded to H. H. Peterson the contract for installing the pipe for the new municipal water system. Harris & Edwards have the contract for making the excavations for the settling basins. J. A. Butterfield has the contract for erecting the pump and engine house.

RATON, N. M.—G. H. Webster, Jr., of Cimarron, arrived here today from Denver, where he has been completing arrangements for work on the new water system to be installed in the next few months in this city. Water will be brought from 7 miles up the Cimarroncito where it will be conserved in a large reservoir. From this basin 76,000 ft. of pipe will convey the water to the city. A 500,000-gallon reservoir will be erected, with cement lining.

TACOMA, WASH.—On February 11, 1911, at 2 p. m. at the office of the mayor of Tacoma, Wash., in the city hall, bids will be received for the Green River gravity water system bonds or warrants of the par value of one million five hundred thousand dollars providing for the construction of the proposed Green River gravity water system. The rate of interest is 6 per cent, payable semi-annually at the fiscal agency of the State of Washington in the city of New York.

TACOMA, WASH.—The Council has adopted a resolution providing for the improvement of the following streets by the construction of water mains as follows: A 12-in. wooden water main on South Seventy-second street, from Park avenue to J street. A 6-in. wooden water main on Park avenue and J street from South Sixth street to South Seventy-second street, and on Yakima avenue, Thompson avenue and I street from South Sixty-eighth street to Seventy-second street, and on South Sixty-eighth street from Park avenue to J street.

ALAMEDA, CAL.—Chief Engineer C. E. Gilman of the Bay Cities Water Company and L. R. Dickie, formerly assistant manager, but now secretary to W. S. Tevis, president of the Bay Cities Company, held a conference with Mayor Noy last week relative to an early commencement of main and pipe laying in this city by the company. The water officials wanted to lease from the city a municipal tract near a railroad siding, on which to store pipe until it was needed for actual laying. They said that the company had 72 carloads of pipe here now, and that within 60 days the installation of the Alameda distribution system would be undertaken.

TELEPHONE AND TELEGRAPH.

VICTORIA, B. C.—The wireless station at Gonzales Hill will be enlarged by the Dominion government.

SELMA, CAL.—The Fowler Independent Telephone Company has filed a certificate of the increase of its capital stock from $7500 to $30,000.

SEWARD, ALASKA.—The Alaska Electric Company contemplate the construction of a telephone line from Seward to the Innoko and Iditarod.

SEATTLE, WASH.—Secretary of War Dickinson will urge in the near future an appropriation for the construction of a telegraph cable from this city to Cordova, Alaska. The line would cost approximately $2,000,000.

CONCONULLY, WASH.—New telephone lines are being considered by T. R. Pinkerton, manager of the local branch of the Pacific Coast Telephone Company. A line is to be run over the Silver Hill country and another through the Pine Creek region.

COLVILLE, WASH.—Deputy County Clerk Willard J. Shelton is associated with Willett Bros., William Spedding and F. C. Ramsey of this place and will start work in the spring on the construction of a wireless telegraph station on the top of the Colville mountains, north of this place. The tower will have an elevation of 1200 feet above the city.

TACOMA, WASH.—The Pierce County Commissioners have granted a franchise to the Equality Telephone Company to construct a telephone line between Sumner and Dieringer and connect with "Sunset' system at Sumner. George W. Edwards, A. A. Hook, W. H. Pierce, Ivan Atkinson and W. H. Wilson, all R. F. D., Sumner, Wash., trustees of Equity Company.

HEALDSBURG, CAL.—At a recent meeting of the Alexander Valley Telephone Co. the following officers were elected: J. W. Cottle, president; E. Moodey, secretary; E. D. Cook, J. E. Metzger and George Brown, directors. The company has decided to open negotiations for the purpose of purchasing the Geyserville exchange from the Pacific Telephone & Telegraph Company.

KLAMATH FALLS, ORE.—W. J. Phillips, division commercial superintendent for the Pacific Telephone Company, has been here for some days looking after the business of this company, which recently acquired the Klamath Falls plant. He states that early next spring his company expects to commence the work of completely remodeling the plant here and making of it one equal to those they have in operation in other cities. The work that this company contemplates here will entail an expenditure of over $30,000.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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HISTORY OF NAPA AND ITS GAS BUSINESS

BY E. C. JONES.[1]

E. C. Jones

Napa, nestling in her inland valley, at the head of navigation on the Napa River, forty-six miles from San Francisco, is one of the most beautiful residence towns of California. It is a community of 7500 people, and the seat of Napa County, which embraces a territory of eight hundred square miles.

Here is a city of homes surrounded by lawns and flowers; possessing all the charm of New England's country towns, with their beautiful shade trees, combined with California's delightful climate and all its gifts.

There are no waste lands about Napa. The town merges insensibly into orchards and farms and a beautiful and prosperous country side. Napa derived its name from the Indian word Nappo, used by the Pomo tribe to convey the idea of numbers—a collection, a group of dwellings. The valley was originally occupied by the Pomo Indians, whose descendants, still famous among aboriginal basket-makers, are now found in Lake County and some other northern district of California. The path of these Indians, as they retreated further and further northward before the white settlers, is marked along the way by names that are traceable exclusively to the vocabulary of the Pomo tribe.

Pomo legends of the old days when the tribe dwelt in the Napa Valley mention the large quantities of fish in the waters there, and particularly the hordes of salmon that annually ascended the Napa River. This abundant supply of their favorite article of food caused the Pomo Indians to congregate about the present site of Napa in a fishing village or settlement, or Nappo.

In 1829 Kit Carson, the famous hunter, visited California on a hunting expedition. In describing the Indian populatian he said that many of the interior tribes were continually at war, while those living near the coast were comparatively orderly and peaceful. The indolence and indifference of the coast Indians he ascribed to the mildness of the climate and the ease with which they could obtain a living.

A Characteristic Landscape Near Napa. Vineyards, Orchards, Wooded Foothills and Surrounding Mountains

In 1830 there were about 3000 Indians within the boundaries of what is now Napa County. The first grant by the Mexican government of land in what is now known as Napa County was made to George C. Yount, who was the first white man to settle in the valley. His grant comprised two square leagues situated in the heart of the valley east of the present site of Yountville, and was given to him by Nicholas Gutierrez, March 23, 1836. After the American occupation of California it was confirmed to him by the United States Board of Land Commissioners February 8th, 1853, and by the United States Court in 1855.

[1] Chief Engineer Gas Department, Pacific Gas & Electric Company.

The Entre Napa Rancho, where the city of Napa now stands, was ceded to Nicolas Higuerra by Manuel Chico May 9th, 1836. This grant and Yount's were the beginning of white settlements in Napa Valley.

George C. Yount was an American and arrived in California in February of 1831. He was accompanied by a young man named Guy F. Flynn, who acted as guide and afterward became a settler in the county. It seems to be a fact that Flynn visited the Napa Valley as early as 1825, and obtained the knowledge of the country that enabled him to act as a guide to Yount. Flynn revisited the valley, located there permanently, and in 1872 he died in a little old house among the Indians near Napa.

Yount did hunting and trapping until 1836, when he built the first log house erected in California by an American. It was eighteen feet square, with an upper story twenty-two feet square in which were portholes for the purpose of defending himself against the Indians. After obtaining from the Mexican government his grant of land, which was known as the Caymus Rancho, he became a permanent resident of the valley, remaining until his death, October 5th, 1865.

Among the early settlers who followed Yount was Nicolas Higuerra, who settled on the banks of Napa Creek. There he built a wicker house, plastered with mud on the outside and covered with a thatch of tule reeds. Two of Higuerra's daughters afterward married into the Berryessa family of the valley in Napa County which bears that family's name.

Bartlett Vines had come across the plains with Yount, and in 1844 he went to Napa on board Captain Sutter's schooner "Sacramento." He was Yount's son-in-law. To the Vines family came the first white child born in Napa County, and, it is claimed, the first American child born in California.

As early as 1841 John Rose and John C. Vines built a schooner at Napa and launched it at a point just above the present stone bridge on First street. It was not much larger than a whale boat. In 1849 they built a barge which was used as a trading boat in all the bay inlets.

One of the curiosities of the olden days in Napa was the first carriage, the property of General Vallejo. It had been at one time the state carriage of the Duke of Wellington. General Vallejo purchased it in London in 1833, and brought it to California shortly afterward. The driver of the carriage rode on one of the horses.

The first Board of Supervisors of Napa County convened December 7th, 1856.

The fertility of the land and the splendid climate of the valley tempted the early settlers to experiment with semi-tropical plants.

In 1861 William Baldridge tried to raise cotton in the Napa Valley, but with no success. His experiments proved that the soil was much better adapted to the growing of grapes than to cotton. To Baldridge belongs the credit of planting, from seed sent him in 1845, the black locust trees that are seen along the coast highways of California.

In 1864 a crop of tobacco was planted near Napa by George N. Cornwall and John Cornwall, with much success.

The first railroad into Napa was completed from Soscol January 10th, 1865. The rolling stock consisted of two cars and a pony engine. The track entered Napa by the way of Main street, and was laid along that street to Third street. The first train passed over the track the 11th of July, 1865.

The original boundaries of Napa County also included all of the territory now known as Lake County until 1861, when Lake County was created.

The first mention of Napa in any newspaper was in an article in the "Californian" in 1848, which stated that the ship "Malek Adhel" had passed up the Napa River and "found plenty of water to a point below the Embarcadero de Napa."

Early in May in 1848 the first building in the town was erected. This, probably by the merest accident, happened to be a saloon eighteen feet by twenty-four feet in dimensions. The historian tells us that the saloon formed a nucleus about which the present city has grown. The lumber for this building was sawed at Bale and Kiburn's mill, two miles above St. Helena.

The site of the town of Napa was surveyed and laid out in the spring of 1848 by Nathan Coombs. The original limits of the town included only the land lying between Brown street and the river and extended six hundred yards from Napa Creek to the steamboat landing. The town was originally divided into upper and lower sections, Napa Alta and Napa Abajo. The Alta section, consisting of more than one hundred acres, was known as Thompson's Addition. The Embarcadero, or landing, was at the head of navigation, and the ford just above it determined the location of the town. That was before the erection of the beautiful bridges, which have added so much to the attractiveness of the Napa Valley.

During the year 1848 John Truebody mowed almost the entire town-site, which was covered with a rank growth of wild oats. He sold the hay to the government. The discovery of gold in that year almost depopulated Napa, as it did other towns in California.

The first bridge across Napa Creek was built in 1849, near the line of Brown street. It was a timber bridge, and the two wooden stringers, each sixty feet long, cost $100 each, which gives an idea of the high price of materials at that time.

Very little United States coin was in circulation then, and even as late as 1856 the medium of exchange was gold dust, foreign coin, or a substitute for coin issued by the assay office of Kellogg and Humbert in San Francisco. These were gold pieces of $5, $10, $20 and $50, were of weight and fineness equal to the United States government standard, and were readily accepted as legal tender. No change was used smaller then a "bit," having a value of twelve and one-half cents. The price of everything, including labor and all classes of material, was enormous. Money was the only thing that was plentiful.

In 1854 the town of Napa had a population of about four hundred, and there were in all about forty buildings. As late as 1856 very little effort had been made to improve the streets or the highways, and both were almost impassable during the rainy season. There were only two places on Main street where a person on foot could cross. Crossings were made

with bundles of straw thrown into the mud until the bottom was found. This is in sharp contrast with the excellent roads for which this county is now noted, some of the best automobile drives in California being in Napa County. All the roads are sprinkled in the summer-time.

It is said of the first newspaper published in Napa, the 4th day of July, 1856, and known as the "Reporter," and it was a "tri-weekly"; that is, they published it one week and tried for another week to get it out again.

Napa was the tenth city in California to introduce gas for illumination. In 1867 William Smith and E. E. Chalmers were granted a franchise but did not op-

filled and sewed, was added to the expense of the coal. The yield of gas the pound from this coal was four to four and one-half cubic feet.

The condenser was of the ordinary return tubular type, made of tin, as was also the centre seal of the purifiers. They were furnished by Morris Dobrzensky, who was the first manufacturer of gas meters on the Pacific Coast. There were two redwood purifying boxes four feet by five feet by three feet, with wooden trays. Dry lime, costing $2.25 a barrel, was used as a purifying material.

All the pipe at the works beyond the condenser was of galvanized sheet iron, with soldered joints, and it was made and erected by Napa tinsmiths.

Napa County Is Noted for Its Stone Bridges.

A Picturesque Old Mill, Near St. Helena, Napa County.

erate under it. They conveyed their rights to James H. Goodman, James Freeborn, and William W. Beggs, who incorporated "The Napa City Gas Light Company" with a capital stock of $80,000, May 25th, 1867. Beggs was at that time the chief engineer of the San Francisco Gas Company. The gas works was located on a lot sixty feet by one hundred and twenty feet on Fifth street, between Main and Brown streets. The brick building was a counterpart, as to size and general design, of the Oakland gas works of that time, also designed by Beggs. The office, condensing and purifying room, and retort house were all under one roof.

A 7000 cubic foot gas holder was constructed in a redwood tank, and there were two benches of iron retorts, one retort in each bench capable of carbonizing 2000 pounds of coal at a charge. Oak wood and the coke made from the coal were used to heat the benches. The coal used for making gas was Scotch and Australian cannels, costing from $20 to $30 a ton. It was freighted by schooner from San Francisco at a cost of $2.50 a ton, with $1 drayage added. At that time all coal sold in San Francisco for reshipment had to be sacked, and the cost of gunny bags,

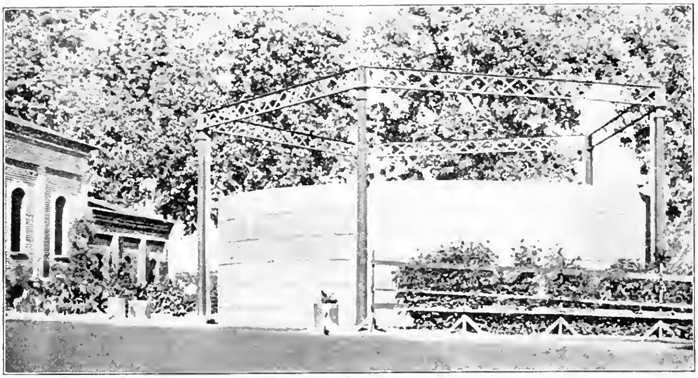
Gas was first turned on in Napa and the town lighted September 1st, 1867. Henry Adams, formerly with the gas company at Sacramento, and later superintendent of the gas works at Oakland, was the first superintendent at Napa.

The original price of gas was $7.50 a thousand cubic feet, and there were sixty-five consumers. The county paid for thirty-three street lights at the rate of $9 a month. These street lights were used only when there was no moonlight.

The first street mains laid in Napa were mostly condemned boiler tubes two and one-half inches in diameter, in six-foot lengths, and joined together by cast-iron sleeves with lead joints.

In April of 1869 Adams resigned as superintendent to accept a similar position at the gas works in Stockton, and he was succeeded at Napa by T. R. Parker. At that time James H. Goodman, James Freeborn, and Captain Harry Parker were the directors of the Napa Gas Company, and Richard Dudding was secretary.

During that year, 1869, prosperity, long held back by the civil war, returned, and Napa felt its good



The Old Gas Plant at Napa, Built in 1888.

The Water Tower in Napa.

effects. The income tax was abolished, and even the gas business in Napa shared in the good times. The price of gas was reduced to $6 a thousand.

Under T. R. Parker's efficient management many improvements in the making of coal gas were introduced, including large clay retorts, each capable of carbonizing three hundred to four hundred pounds of coal. The purifying house was remodeled, and the street-main system was thoroughly renovated and enlarged. The rates on street gas-lamps were also reduced to $6 a month each.

It was about that time that bituminous coals for gas-making were brought from Vancouver and Australia to take the place of the more expensive cannel coals which had previously been used.

These cheaper coals were Nanaimo from Vancouver and Greta and Wallsend from Australia. The gas made from them was enriched with Anvil Creek cannel, or shale, from Australia. Coke in those days sold at $20 a ton, and tar at 10 cents a gallon.

These improvements increased the earning capacity of the company so that dividends were declared at the rate of 15 per cent on the actual investment. Also the company voluntarily reduced the price of gas to $5 a thousand, and the rate on the ninety street lamps to $4.50 each a month.

The 13th of August in 1888 the directors of the company decided to erect a new gas works. John Fullagar, formerly superintendent of the gas works at Cincinnati, Ohio, was employed to construct it. The company was disincorporated, and then re-incorporated under the name of the Napa Gas Light & Heating Company. The articles of incorporation were dated November 20th, 1888. The first board of directors of this new company consisted of George E. Goodman, Theodore R. Parker, E. S. Churchill, Isabella Parker and James Freeborn. H. P. Goodman was secretary, and John Fullagar was superintendent. The new gas works was erected on the site of the present works and included a 20,000 cubic foot gas holder and a complete six-inch coal-gas works, with Hicks settings of clay retorts. The price of gas was again reduced, and made $4 a thousand, and the street-lamp rate was reduced to $3.50 for every night and all-night service.

T. R. Parker.

The Gas Works at Napa.

In 1889 Fullagar resigned the superintendency to take charge of the gas works at San Jose. This brings the Napa gas works down to the time the writer took up his residence in California.

Coming in 1889 from the east, where the highest types of coal-gas benches were in use and where there was a rivalry among different plants to obtain the best results, it was a pleasurable shock to me, upon visiting the little coal-gas works in Napa under the able management of T. R. Parker, to find the retort house equipped with the most modern type of full-depth regenerative benches, containing five retorts, each capable of carbonizing a ton of coal in five hours, and giving an average yield of 11,000 cubic feet for each ton of coal. Such results were better than were then obtained in some of the best eastern gas works. In looking about for the reason for such results I found it in the skill and ingenuity of T. R. Parker. He had applied his own improvements to the best knowledge then obtaining in the east, and his gas plant there at Napa surpassed in results attained all the other coal-gas works in California. Coupled with mechanical excellence was the highest degree of cleanliness possible in a gas works. About the buildings the grounds were laid out in gardens of roses and cannas, and round the gas holder tank were beds of calla lillies, while at the back of the garden were trellises completely embowered with purple wistaria. Everywhere, inside and outside the works, was evident the touch of Parker's knowledge and good taste.

In 1893, at the organization of the Pacific Coast Gas Association, T. R. Parker was one of the charter members. To his enthusiastic good work much of the first and continued success of the association is due. He immediately took charge of the "Wrinkle Department," and the splendid results of his conscientious work are a matter of record in the proceedings of the association. In 1897 T. R. Parker was elected president of the Pacific Gas Association, and he performed the duties of the office with credit to himself and profit to the organization.

Then came electricity as a rival of gas. In November of 1899 Dr. Thomas Addison, coast manager of the General Electric Company, and John L. Howard purchased the old steam electric plant in Napa from the General Electric Company and the Napa gas works from the George E. Goodman bank people.

O. E. Clark was then appointed manager of the combined enterprises, with T. R. Parker as superintendent of the gas works.

During all those years T. R. Parker had also managed the interests of the Napa City Water Company, as its superintendent. When the city was small he was able to attend to both the water and gas works, but with the growth of Napa and the consequent increase in the use of water he decided to devote his attention entirely to the interests of the Napa City Water Company. One of the accompanying illustrations shows the water tower at Napa, which he designed. It stands as a sort of landmark, and as a reminder of what the long influence of T. R. Parker has meant to that city beautiful.

At the time of the consolidation in 1899 George E. Goodman, who had been associated with the Napa gas interests from the beginning, severed his connection with the business.

An illustration accompanying this article shows the beautiful library that building George E. Goodman presented to Napa, with the proviso that it should always be used "as a library and a resting place for the country people during their trips to town."

Public Library Presented to Napa by George E. Goodman, Formerly President of the Gas Company.

The Napa gas works was operated by the new owners until the winter of 1902. Then the company was purchased by the California Central Gas & Electric Company, and O. E. Clark was retained as manager of the new concern. Since then the Napa Gas Light & Heating Company has become one of the subsidiary companies of the Pacific Gas & Electric Company.

As fuel oil became plentiful in California, and the new method of making gas from petroleum was rapidly superseding the use of coal, the gas works at Napa was equipped with a complete oil-water-gas plant, with a capacity of 5000 cubic feet an hour. A 20,000 cubic foot relief holder was added to the plant, as well as a 500 barrel tank for the storage of oil. At the time the works was taken over by the California Gas & Electric Corporation the daily output of gas was from 12,000 to 15,000 cubic feet. At the present time, in 1910, the output is 45,000 cubic feet a day. During the period since the introduction of fuel oil the distributing system of pipes has increased from six and one-half miles to twelve and one-quarter, or nearly double.

PETROLEUM PRODUCTION.

According to the figures of Dr. David T. Day, Geological Survey statistician and oil expert, the production of oil in the United States in 1910 was between 204,000,000 and 208,000,000 bbls. of 42 gals. each.

The estimated oil production in 1910 in this country is as follows—in bbls. of 42 gals. each:

Field.	1910.	1909
California	77,000,000	51,133,010
Illinois	34,450,000	30,898,339
Appalachian and Lima-Indiana fields	33,000,000	31,717,287
Gulf and Caddo, La.	14,000,000	11,912,058
Midcontinent and Rocky Mts. fields	53,000,000	50,243,608
Totals	210,450,000	182,134,271

WATER LAWS OF WASHINGTON.

BY JOHN C. STEVENS.

The following is a summary of present Washington statute law relating to water rights, published in Water Supply Paper 253 of the U. S. Geological Survey and abridged from a summary of irrigation law prepared by Ralph B. Williamson, attorney, United States Reclamation Service:

Appropriation and Acquiring of the Right.

The right to use the waters of the State may be acquired by appropriation, the first in time being the first in right. Written notice must be posted near the point of intended storage or diversion, stating the amount, purpose, places of use and means of diversion or storage, and such notice must be filed with the county auditor of the county where the notice is posted for record within ten days. All amounts must be multiples or fractions of a cubic foot per second of time.

Construction of works.—An appropriator must begin construction of works within three months after posting of notice if use is by storage; if by diversion within six months, and must diligently prosecute them to completion, compliance with which gives priority as of time notice was posted. It would seem that actual construction of a ditch gives right to unappropriated waters at the time construction is begun for irrigation and pumps may be used when the land cannot be reached by gravity flow. Head-gates of existing canals may be changed or extended on streams where naturally made necessary, subject to existing rights.

Filing of maps.—Within ninety days after construction or enlargement of a canal, there must be filed with the county clerk of the county in which the headgate is located, a map showing location of head-gate, route of ditch, legal subdivisions crossed and names of owners, with statement showing location of works, depth, width, and grade of ditch, its carrying capacity and time of commencement of the work. Such filing will give priority from date of commencement of the work; if after ninety days, only from date of filing of the map.

Seepage and springs.—Water from seepage and springs is governed by the general laws, provided that a man on whose land such waters first appear has prior right thereto; and a man whose lands have been thus irrigated by seepage, has priority as of time of use of seepage, if by natural cause he must construct ditch to source of seepage to irrigate the lands. The same rule applies to artesian wells.

Change of use.—The purpose of appropriation may be changed to any beneficial use without losing the priority of the original appropriation.

Transfer.—The right to the use of water is not made appurtenant to land but is allowed to be transferred, like property, by deed.

Surplus waters.—Riparian owners of lands on any stream are given the right to use any surplus or unappropriated waters. The same privilege is granted to non-riparian owner.

Loss of rights. It is provided that failure to comply with the requirements of the statutes deprives the appropriator of his priority against a subsequent appropriator. Lack of diligence in construction forfeits rights.

Right of Way.

State lands.—Right of way across State lands is given to irrigation districts for all irrigation work.

Private lands.—A right of way for ditches sufficient for the purpose required is given to all persons, corporations, etc., who may have a right to use water and may be acquired by condemnation. Such right of way must be the shortest possible route across such land and no land owner will be burdened with more than one ditch, if one will serve the purpose.

Natural streams.—Any person may take water which he has acquired the right to use along any of the streams or lakes of the State, not raising the water above high-water mark.

Eminent Domain.

Public use.—The use of the waters of the State is deemed a public use and the right of condemnation is given to all persons having a right to use it, for purposes of acquiring rights of way. Procedure is provided in Laws of 1899, page 262.

Riparian rights.—Riparian rights in any natural stream or lake may be condemned but this applies to riparian rights and cannot be applied to take water from the person himself using it for irrigation. Procedure is prescribed.

Duties of Ditch Owners.

Head-gates, embankments, repairs.—Every ditch owner, owner being the person having charge and control and liable as owner, must erect and keep in good repair a sufficient head-gate at the head of his ditch to control the ordinary flow therein. He must keep embankments and all flumes or other conduits in good repair so as not to injure the premise of others. He is made liable for damages resulting through refusal or neglect to comply with these provisions.

Waste.—Drain ditch shall be provided to return water to stream with as little waste as possible.

Unnecessary diversion.—It is unlawful for any person to run a greater quantity of water through his ditch than is absolutely necessary for irrigation of lands watered and for domestic and stock purposes. A violation of this provision is a misdemeanor punishable by a fine not exceeding $1000.

Determination of Rights.

Basis of determination.—Whenever called into question in any court or before any commissioners (infra) the determination shall be based upon the used volume of water annually flowing in the stream or lake, and in the event of unusually low water, all rights shall be proportionately reduced.

Hearing and adjudication of priorities.—When the owner of any canal in any water district (infra) shall present a written petition to the superior court praying the court to adjudicate priorities between the several canals in the district, the court shall, if deemed practical to proceed, appoint a day to commence to hear and take evidence in such adjudication. All interested parties may offer evidence. The court shall ascertain the date of commencement of the ditch, its original

size and capacity, or the time of enlargement and increased capacity, the diligence of construction, and all facts tending to show compliance with the law. He shall determine on the evidence, the priority of appropriation with amounts which each has perfected thereunder, expressed, if possible, in second-feet; if not, by width, depth, and grade of canal.

Certificate.—The clerk shall issue, upon reasonable fee, to each party interested, a certificate, showing dates and amounts of appropriation adjudicated and specifying number of the ditch and of the priority.

Procedure.—Notice of time for adjudication shall be published once a week for four successive weeks; notice containing a copy of said order shall be posted in ten public places in water districts, and proof of such publication and posting shall be made. Service of notice is also provided for.

Decree.—The court in its decree shall number the ditches in the district in the order of priority, and also number appropriations consecutively, beginning with the oldest. Both shall be incorporated in said certificate of the clerk, issued to claimant.

Distribution of Water.

Water districts.—Each county in the State shall be constituted an irrigation district.

Water commissioners.—A commissioner for each district may be appointed by the county commissioners in each county, at a salary fixed by them, provided that if 12 freeholders, irrigating lands, shall petition therefor the county commissioners must appoint such commissioner.

Such commissioner shall take oath of office and give a bond as may be required by the county commissioners, for the faithful performance of duties, and shall be entitled to compensation at $4 per day, actual employment.

The commissioner may, in emergency cases, employ one or more assistants, who take the same oath and shall receive $3 per day.

Duties of commissioner.—Commissioners must divide the water in natural streams among the ditches taking water therefrom, and in times of scarcity must shut down and fasten head-gates of ditches not entitled to water.

Register of priorities.—A register of priorities must be kept by commissioner when such priorities shall have been determined by commissioner from decrees or other legal source. He must keep record of certificates of courts (supra), with contracts of same.

Court Commissioners.

Where insufficient water.—When volume of water in any stream is insufficient, upon application of any party interested, the superior court shall appoint three commissioners to go upon such stream and apportion water, as they may deem equitable. Such apportionment shall be for domestic purposes before any is given for irrigation.

To determine proper diversion.—In the same way the court shall appoint three commissioners to inquire and determine whether or not more water is being diverted than is properly used. Their decision is final. They may order the ditch owner to turn back unnecessary water. Failure to comply with the order is punishable as contempt of court.

Rotation of water.—In case of insufficient water in a stream to supply the wants of the entire country through which it passes, the superior court shall appoint three commissioners to apportion in equitable manner a certain amount of water upon alternate days in certain localities with due regard to legal rights of all.

Individual ditches.—When any ditch shall not be entitled to a full supply of water, the amount actually diverted shall be prorated among shareholders and users of water in such ditch.

Miscellaneous Provisions.

Interference with appliances.—Every person interfering in any way with head-gates or measuring boxes without authority shall be guilty of a misdemeanor and subject to a fine of not less than $25 or more than $100, or maximum imprisonment of six months or both.

Injury to ditches.—Any person breaking or injuring the embankment or head-gates of any ditch with malicious intent, or for private gain to injury of persons lawfully using said ditch, shall be guilty of a misdemeanor, punishable by the maximum fine of $500 or maximum imprisonment of six months, or both.

Corporations deemed common carriers.—Any corporation organized in the State therefor may construct ditches for irrigation, and may condemn rights of way therefor, whether or not said corporation owns lands upon the line of such ditch. Such corporation is deemed a public carrier, and is subject to legislative rules and regulations relating thereto.

Federal Government.—Authority is given to the United States to avail itself of the provisions of the law. Upon authoritative notice to the land commissioner that the Government contemplates the construction of irrigation works, all waters specified will be withdrawn from appropriation under foregoing laws for a period of one year, which withdrawal may be extended three years by certificate from duly authorized agent within the said year that work undertaken appears feasible and further investigation is intended to be made; and upon the letting of contract for construction work the United States may appropriate all unappropriated waters in the manner provided for private persons, the title to beds and shores of state lakes thus utilized passing to the United States upon such appropriation.

OBJECTIONABLE FEATURES OF PUBLIC SERVICE COMMISSION LAWS.

There is great likelihood that Public Service Commissions will be established in several of the Western States during the coming year. Results obtained in a number of Eastern States have pointed out certain principles to be adopted and certain principles to be avoided. A number of objectionable features of the New York code are here summarized:

More vital even than the provisions of such a law would be the personnel of the members of the commission. The day has passed when public service corporations can expect any special favors, and they are

more than satisfied if the treatment they receive is as fair as that extended to the ordinary citizen and taxpayer. The business of managing and controlling a public service corporation is one which requires not only a very considerable ability, but also a vast amount of intelligent study. Primarily then the members of such a commission should be able men who understand the management of public service corporations and who are able to devote all their time and attention to their duties. The commissioners under the New York act receive a salary of $15,000 and in order to insure the class of men which the duties demand it would be necessary that any commissioner appointed in the Western States should receive a salary of at least $10,000 a year. If public service corporations have to be regulated it should be by men of intelligence and ability whose salary places them beyond temptation, and the dignity of their position beyond the danger of being swayed by popular prejudice and passion.

Such a commission should be vested with the absolute veto power in the matter of all franchises granted by municipalities. This idea is not fostered by the feeling that existing companies desire to keep out competition but from the fact that experience has shown that where the territory will not support two companies one is invariably absorbed by the other, with the result that the public is compelled to pay interest upon a double investment covering the same territory. Careful inquiry should be made by the commissioners as to the financial backing of companies seeking to enter a field already supplied. It should also study carefully the ability of the community to support two companies together with the quality of the service furnished, and the fairness of the prices charged by the existing company.

There are in the New York act many clauses general in their nature and vicious in their possible application which in themselves add nothing to the force of a bill but would give to a radical commission almost unlimited power, such as Paragraphs 5, 8, and 9 of the New York Act.

Under the system of taxation which now probably prevails in several of these States and which is possibly as fair a method as can be found, the net earnings of public service corporations are limited to a certain income upon the investment in the shape of dividends. In other words, when the net income of a public service corporation exceeds a certain per cent of its capitalization the State will claim the balance for taxes and in order that the net income may be as large as possible, so that the taxes may be increased, an attempt will be made to jealously guard what a commission might term exorbitant salaries to officers and employees. For this and for the added reason, that the corporation in the management of its own business should be the sole and exclusive judge of the compensation to be paid its employees and officers, the fifth condition of Paragraph 6 of the New York code seems pernicious.

Section 67 of the New York code provides for the inspection and testing of meters; that portion of this section which provides for an inspection of meters at the expense of the corporation prior to their installation puts an unnecessary expense upon the company and the consumer is certainly amply protected by the succeeding section which gives him the right to have the meters tested after they have been installed and compels the company to pay the cost of such test, provided the meter is found to run fast, permitting a variation of 4 per cent.

Section 69 of the New York code, if literally construed, practically gives to the commission the right to arbitrarily refuse to permit the issuance of bonds by public service corporations for the purpose of making desired extensions and improvements or to pay indebtedness already incurred. Surely if the corporation is to be taxed upon all the property it possesses, including its franchises, if the quality of its product and the price charged is to be regulated and fixed by the commission, then at least the corporation should be permitted to manage its own affairs to the extent of making additions, alterations and extensions which are of such acknowledged beneficial nature that it is able to borrow the money in the open market to effect them.

Insofar as the constitution of the various Western States will permit any such act should give to the commission the same power to regulate and control the municipal plant as it is given to control the public service corporations, the same return which is required from the public service corporation regarding the salary paid to its officers and employees, the rates charged to its customers, its bonded indebtedness and its gross and net earnings, should be furnished by the municipal plant in order that the people who are forced to pledge their property for the support of such a plant may for the first time be able to learn the truth regarding its operation. In many cities a systematic effort has been made by the officials of municipal plants to conceal from the public the true facts concerning the maintenance and operation charges and the profits or loss resulting from such operation. Bonds have been issued under the pretense of making necessary extensions, the proceeds of which have been used to make up deficits which have occurred from loss in operation, and any public service commission should be vested with the right to bring the true condition of such plants to the knowledge of the people who support them.

Section 70 of the New York code gives to the commission the power to arbitrarily refuse permission to any gas or electric corporation to sell or lease its franchise or any portion of its property, or to contract for the operation of its system, and also prohibits the holding of stocks or bonds of any other corporation engaged in a similar business. This section reverts again to the question of the management of the company itself, which should not be given to the commission, but should be retained by the individuals who have invested their capital therein, and again we repeat that so long as the commission is gven the right to fix the quality of the output and the price to be charged and to regulate the method in which the service shall be made it should not be permitted to interfere in the management and operation of the plant itself.

Insofar as such a bill seeks to regulate the manner of service, the quality of the output and the rate charged we do not believe that the companies would be injured, and especially is this true if men of ability who will give the subject study are appointed

CORONA[1]

BY HARRIS J. RYAN.

The fundamental purpose of this paper is to discuss the high tension transmission corona problem in the light of the evidence available at the date of its preparation. As ionization plays an important part in all phenomena that lead to the formation of corona it is first requisite to have a thorough knowledge of the origin, inherent qualities and characteristic behavior of ions, i. e. of the electricity carriers in gases.

Every material substance is made up of atoms or their elemental aggregations, molecules. Each kind of substance has certain distinctive characterisics because of some structural character of its atoms. All kinds of atoms have one feature in common. Each atom holds through electrostatic attraction a certain number of relatively minute particles. The number of these particles is different for different atoms. Each particle is the seat of a certain definite electric charge. The amount of this charge is 4.05×10^{-10} electrostatic units—perhaps a little larger, not exceeding 5×10^{-10} electrostatic units. In the literature of the subject this ultimate particle of matter is burdened with two names electron, the one apparently in more general use, and corpuscle, the original term used consistently by some of the best known physicists. The frame of the atom is the whole of the atomic structure less the electrons and their non-detachable electrostatic fields.

A positive ion is formed when any neutral atom, molecule or atomic aggregation has, through any cause lost one or more electrons—usually but one. It thus becomes a positively charged ion. If the gas in which it is located is pervaded by an electric field it will be subjected to a corresponding force that will cause it to migrate in the general direction of the cathode or negative terminus of the field. The smallest positive ion is, therefore, a single atom that has one less than its normal quota of electrons. The largest may be any aggregation of atoms or molecules held together by the electrostatic field due to the loss from the normal stock of the aggregation of one or at the most a very few electrons.

A negative ion is any free electron, or any atom or unit atomic aggregation that has captured electrodynamically one, or at the most, a very few electrons more than the supply that constitutes the neutral atomic state. The smallest negative ion is a single electron—vastly smaller, therefore, than the smallest positive ion. The smallest positive and negative ions are alike, therefore, in the charges they carry and forces with which they are drawn through a common electric field. In sizes and masses of the smallest ions, the positive is, therefore, far greater than the negative ion. It follows that the mechanical activity of the smallest negative ion is far greater than that of the smallest positive ion.

In the open air, the natural ions present are in a comparatively quiescent state. By their electrostatic forces they have captured various molecular aggregations, generally made up mostly, though not necessarily, of water. These captured aggregations are retained while the dynamic activity of the ions is low. When, however, this activity is increased, by the presence of a sufficient electric field, such as is comparable with the fields set up about high tension circuits, the forces that have captured and retained the aggregations are no longer sufficient to hold them and they are lost. Thus it occurs that all ions that take direct part in the corona formation or in the essential phenomena that precede the corona state are only those of smallest size, viz., the electron and the neutral atom less an electron. This is so because all such phenomena are brought about by ions in a high state of electrodynamic activity.

The sources of ionization about high voltage transmission lines are:

Radioactivity that is entirely natural in the open air,

Impact of ions at the surfaces of conductors caused by the electric field, and

Collision of ions and atoms when the field exceeds the critical ionizing strength.

Every conductor exposed in the open collects upon its surface some radioactive emanations—the real essence of the "dirt" that causes the cathode conductor to start part-corona at abnormally low voltages. These emanations carry positive charges. The result is that the earth whence they escaped must carry a negative charge. Such a state gives rise necessarily to a positive charge of the atmosphere relative to the earth, the difference of potential depending upon the number of excess positive ions present and varying largely with altitude and topography. The electric field, and therefore radioactive emanations, is smallest in the canyons and highest on the peaks.

Without the prior existence of these natural ions in the air corona would not be formed except at extraordinary stresses. Whenever an ion, under the influence of an electric field, collides with an atom they "ionize by collision," i. e. each electron that strikes an atom of air in a stress above 76 kilovolts per inch does so at sufficient velocity to detach from such atom an electron. Two new ions are thus formed: the negative electron, and the neutral atom which lost it, and which was thereby given a corresponding positive charge and became a positive ion. The negative ion collides with the next atom and thus the ionization process builds up rapidly by geometric progression. Ionization by collision is always accompanied by luminousity, and is the cause of visible corona, part corona, brush discharge, sparks and ultimately arcs. Corona for all cases is simply a spark discharge phenomenon wherein the conductor is one electrode and the air conducting by diffusion is the other.

Under practical conditions, therefore, no corona will form on electrodes of either sign without a natural source of ionization and none will be formed at the negative electrode without some form of negative ionization at its surface or very near thereto. The known sources of negative ions at the surface of the cathode conductor are impact of positive incoming ions, radioactive emanations (dirt captured by the cathode and near the surface) and collision with neutral ions. Of these three impact is of predominating influence.

Each conductor is enclosed by a zone or envelope

[1] Abstract of paper submitted to the American Institute of Electrical Engineers through the San Francisco Section for the January 13, 1911, meeting at New York.

having a depth of a few inches within which the total stock of captured ions are actively moving to and fro. The formation of such a collision ionization envelope about the conductors of a high voltage transmission line is the fundamental feature of corona. Under normal atmospheric conditions the critical stress required to start ionization collision when regularly distributed is 76,000 volts per in. at a critical striking distance depending upon the distance between conductors and their diameter. This critical stress varies directly as the barometric pressure and inversely as the absolute temperature.

Conclusions

1. Ionization and the travel of ions under electric stresses are the causes of failure of the open atmosphere as an insulator and they are the cause of corona formation.

2. All ordinary failures of the atmosphere under stress are developed through ionization by collision which can be started under usual high-voltage electric stresses through the presence of some natural or antecedent supply of ions.

3. Variation in the supply of natural ions in open air is the cause of the erratic variation of critical loss-voltages. Such variations have little effect upon the values of the part-corona voltage that has increased the atmosphere loss by the small amount equal to the loss caused by the inevitable ion-convection current.

4. The figure of the electric field about the high voltage conductors determines the facility with which the migrating ions will concentrate the electric stress near the surface of the conductor and thus render the resulting corona irregular at all stages, causing it to be started and to be maintained at correspondingly lower voltages.

5. The turbulent elements introduced by variations in the amount of natural ionization have so small an effect upon the corona forming pressures, and the field irregularity factor above referred to is so nearly constant over a wide range of conditions, that the rational formula as developed should be found dependable to a reasonable extent.

6. The term "dielectric strength" as applied to the open atmosphere, from the inherent nature of things, can have no definite meaning.

7. The rupturing strength of the normal atmosphere rests upon two factors only, (1) quantity of ionization produced by the rupturing voltage, (2) the distance between the electrodes. The rupturing gradient varies from 300 kilovolts per in. (120 kilovolts per cm.) at lowest ionization to 3 kilovolts per in. (1-2 kilovolts per cm.) at highest ionization with no indication that the limits at either end of this range have as yet been found.

1. The failure of the oil as an insulator is due to ions liberated by the electric stress from the supply of free ions in the metals of the electrodes.

2. The electric stress required to detach ions from metals to the oil is much lower than the corresponding stress for a gas.

3. The further conclusion follows necessarily that a compressed gas must, in regard to insulating quality alone, be superior to oil.

THE JOBBERS' MEETING.

The Pacific Coast Jobbers' Association met in convention at Del Monte, January 19, 20 and 21, 1911. Friday was devoted to the business meeting and the balance of the time to social features and entertaining their friends. The great event was the golf tournament on Saturday and the weather, as is usual at Del Monte, was everything that golfers could ask for.

GOLF TOURNAMENT.

Pacific Coast Electrical Jobbers' Association—18 Hole Medal Play, Handicap.

		Gross	Hdcp.	Net
Burger	74-54	128	27	101
Carrigan	49-52	101	+11	112
Carter, H. V.	51-52	103	2	101
Dwyer	56-58	114	27	87
Elliott	66-57	123	17	106
Goodwin	48-45	93	+13	106
Gleason	48-58	106	+6	112
Graham	61-52	113	27	86
Gregory	65-50	115	14	101
Hall	68-51	119	5	114
Hillis	50-48	98	0	98
Holabird	50-48	99	+5	104
Poss	59-57	116	27	89
Sanderson	48-47	95	+4	99
Seaver	79-65	144	27	117
Squires	63-63	126	18	108
Wiggins	91-72	163	27	136
Lillard	54-53	107	5	112
Cole	65-66	131	27	104
Strong	71-59	130	27	103

The banquet in the evening was graced by the ladies, who seemed to greatly enjoy the witty remarks of the mere men. After N. W. Graham, winner of the cups, had told in minute detail just how he had accomplished the unexpected, Mr. Charles Wiggins was called upon to offer his excuses for winning the booby prize, a miniature silver cup of exquisite design, and in his happy way he told the story.

John R. Cole in a silent speech made the hit of the evening as it brought forth round after round of applause and laughter. C. C. Hillis read the following verses that will hereafter entitle him to the honor of poet laureate of the Jobbers:

THAT GOLF GAME.

If you list to me a moment
A story I will tell.
It's of a little game called golf
That some of us play well?

Now the tale I will unfold,
Concerns a game we played today
On the golf links of Del Monte,
Near the town of Monterey.

The players, mostly Jobbers,
With their allied guests, I think,
Put up a score which makes us sore
And drives us all to drink.

We played for a beautiful trophy,
Known as the "Jobbers' Cup."
The winner earned it fairly,
And I suppose he'll set 'em up.

We have a Golf Committee,
Russel D. and Billy G.
It twice helped Bill to win the can,
But Russ is still an also ran.

The winner tall of stature,
Broad of shoulders, thin of frame,
Proved a mighty classy golfer
And Newt Graham is his name.

And there was E. J. Dwyer,
As the schedule runner up;
The Lord can only tell you
How he tried to win that cup.

Also Frederick Brockway Gleason,
Charming, handsome, debonair;
His driving form was perfect
But the balls went everywhere.

There was still another player
Called Grouchy Sandy near and far.
His usual game is rotten,
But his swearing's up to par.

We also have a player
By the name of John R. C.
He is an awfully decent fellow,
But his game—Oh! Hully Gee!

Colonel Carter's mighty handy
With his golf sticks, now and then
He plays some holes in bogey,
And on others he takes ten.

And another classy golfer,
Andy Carrigan by name,
Once won the cup with an eighty-nine
But will ne'er score so low again.

The distinguished looking journalist,
The well known Mr. Strong,
Played a game that's most surprising,
'Cause he's not been playing long.

And the copper magnate, Seaver,
Made a really wondrous score,
We are mighty glad he's with us
And we hope he'll come some more.

The score that took the Booby Cup—
It really was a sin—
Was made by Charley Wiggin,
With the whiskers on his chin.

We must not forget our Albert,
Occasionally golfer, just for fun;
Who wastes no mental energy keeping score,
And says it can't be done.

He scores with a small contrivance
Often used for counting poles,
And it registers correctly
When his ball stays out of holes.

But if he once gets in the bunker
Or his ball gets in the rough,
He counts strokes only in the fair way,
For he thinks these quite enough.

And our old friend Tracy Bibbins,
Now so many miles away,
We could bet a million I could guess
What he's thinking of today.

There's a lot of other fellows
I would like to tell about,
But I'm an amateur at rhyming,
So I'll have to cut it out.

Everyone present said something more or less, until Albert Elliot, in most beautiful language echoed the sentiments of all present in their deep regret that Mr. Tracy Bibbins was absent on account of illness. W. H. Seaver of the American Steel & Wire Company delivered an able address on "Co-operation."

One of the principal results of the meeting were the suggestions for the California meeting of the National Electrical Supply Jobbers' Association in the spring of this year. A special train will convey the jobbers and their wives and the manufacturers from all Eastern points to Del Monte where the business sessions will last from Wednesday to Saturday. The exact date of the convention has not been fixed.

In addition to the business sessions which shall probably be five in number, there will be athletic feats and outings of all kinds. One afternoon will be devoted to a trip over the seventeen-mile drive. A lunch will be given to the ladies of the party at Pebble Beach.

The golf tournament will be played by the jobbers and also by the manufacturers. Splendid trophies will be played for in all the events.

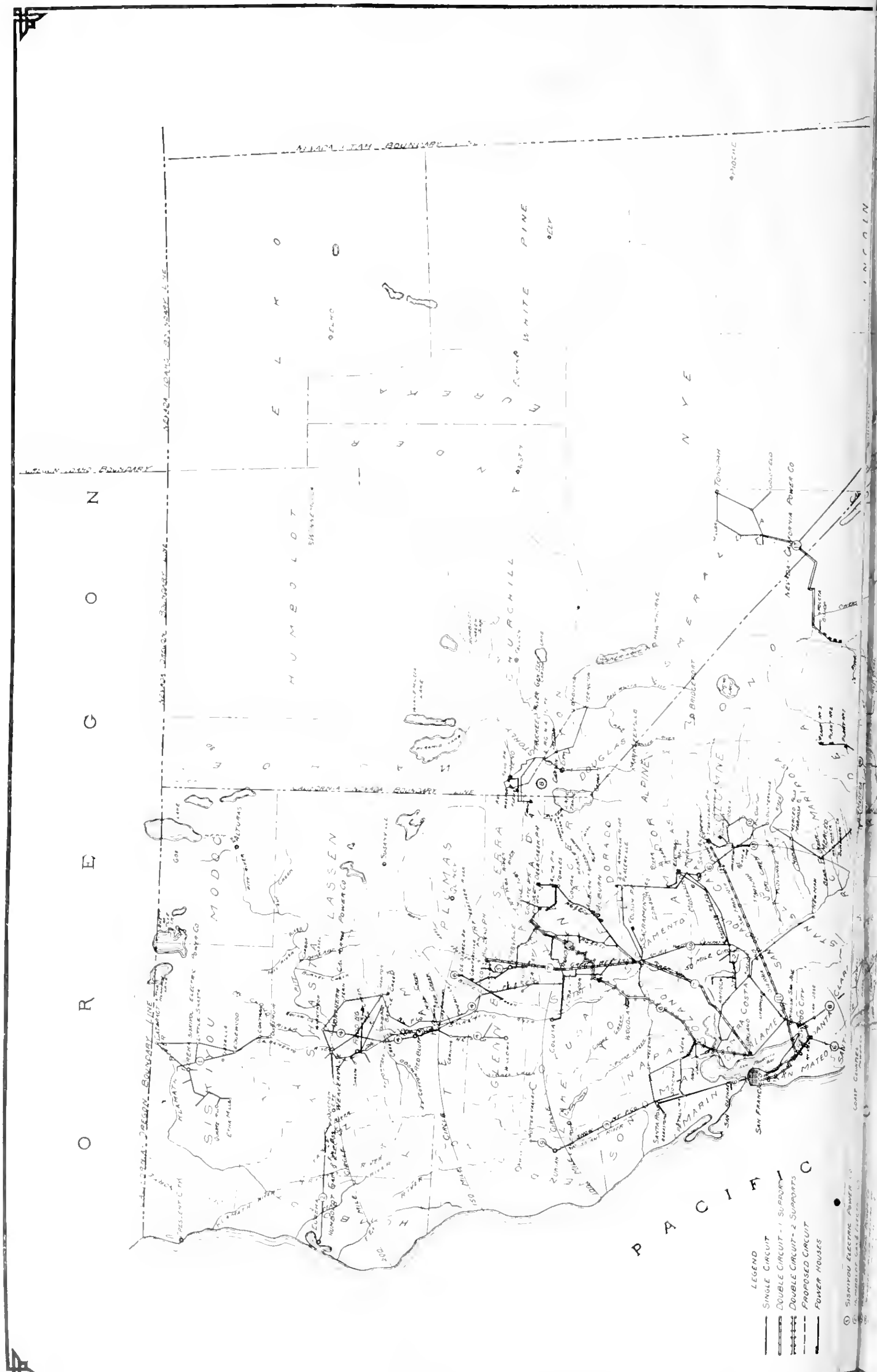
A dance will be given at the hotel one night and a concert by the band another night. There will be bowling, billiards, pool, trap shooting, tennis and push ball.

The festivities of the occasion will wind up with a Spanish supper in old Monterey on Saturday night. There will then take place the presentation of trophies, Spanish singing and dancing and a general good time.

The hotel management has given the jobbers to understand that they will own the hotel for the week during which they and their wives will be there. The official program will probably be issued by the general secretary in the near future.

BUREAU OF STANDARDS.

The work of the Bureau of Standards during the past year has been one of activity and interest. The researches conducted by the Bureau upon methods of measurement of length, mass, capacity, density, time, heat, light, electricity, and the properties of materials emphasize the central position of precision as a factor in science and industry. Measurements on standard cells and standards of resistance were made, intercomparing those brought from the foreign national laboratories and those of the Bureau of Standards, and also comparing the types of silver voltameters used in the several countries. The numerical value for the Weston normal cell, to be recommended to the International Committee on Electrical Units and Standards, was agreed upon, and it is hoped will soon be adopted by all civilized countries of the world. The conductivity and the temperature coefficient of copper have been determined, and the results will be published in the Bulletin. The work on the absolute measurement of current is nearly completed after several years careful experimental work. The research on the properties of mica in standards of capacity is complete and ready for publication. Special electrical testing instruments, designed and built at the Bureau, are now in use and allow much more accurate and rapid measurement of current, voltage and power. The methods of measuring magnetic permeability and [illegible] adopted afford reliable results.


OREGON
PACIFIC
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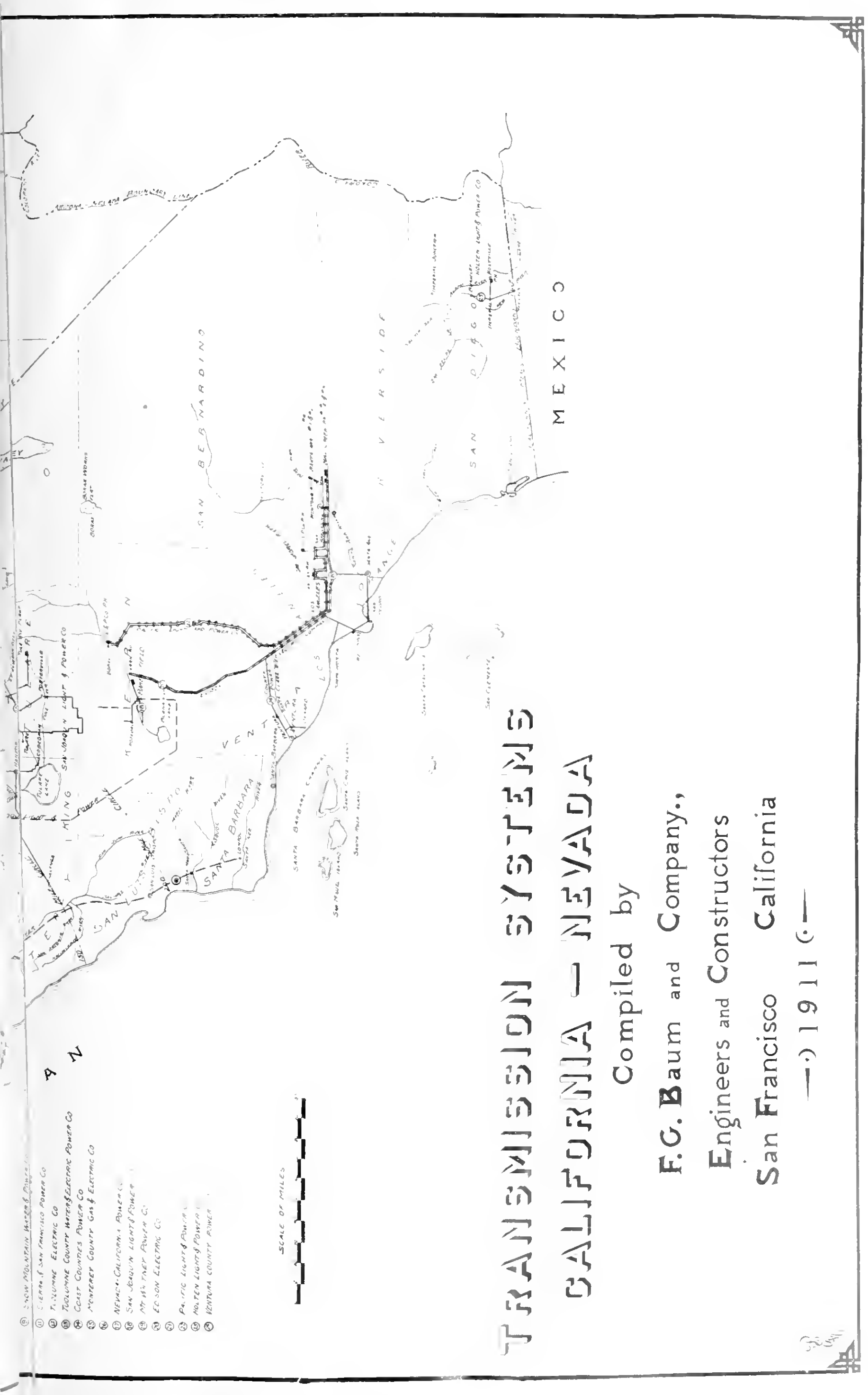
SINGLE CIRCUIT
DOUBLE CIRCUIT - 1 SUPPORT
DOUBLE CIRCUIT - 2 SUPPORTS
PROPOSED CIRCUIT
POWER HOUSES


TRANSMISSION SYSTEMS
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MEXICO
SAN BERNARDINO
RIVERSIDE
SAN DIEGO
SANTA BARBARA
SCALE OF MILES

PETROLEUM IN MEXICO.

The development of the oil fields near Tampico is having an important effect on the development of the entire Republic. The great importations of oil well machinery and oil well supplies have greatly increased the volume of business of the port of Tampico. The products of the fields furnish fuel, in part at least, for the railway systems of the country and will furnish Tampico with a cheap fuel which will greatly aid in its development as a manufacturing center.

From the petroleum produced gas is manufactured in Mexico City which not only supplies that metropolis with cheap light, but also with a cheap fuel by means of which the residents of that city will be enabled to heat their homes during the cold winter months, instead of suffering with the cold as heretofore. The streets of all of the larger cities as Mexico City, Guadalajara, Monterey, Chihuahua, Tampico, and others are being paved with asphalt distilled from the product of these fields. Roads in various parts of the Republic are being improved by the use of oil. All of these results are being brought about by new industries which have been made possible by the development of these oil fields and which give employment to large numbers of men and thus contribute to the general prosperity and development of the country.

The American Doheny syndicate controls companies and subsidiary companies engaged in the development of the oil fields in the Tampico section and in the marketing of the products made from the crude oil, whose holdings represent an investment of almost $30,000,000 gold. These properties include the oil producing properties of the Mexican Petroleum Company of California, at Ebano, San Luis Potosi, the Huasteca Petroleum Company, the Tamiahua Petroleum Company, and the Tuxpam Petroleum Company, all of which are operating just south of Tampico in the State of Veracruz. Other properties include the gas plant of the Mexican National Gas Company, at Mexico City, the paving plants of the Mexican Asphalt and Construction Company in Mexico City, Guadalajara, Puebla, Chihuahua, and Tampico, and those to be established in the near future in Monterey, Durango and Morelia.

Until recently the only producing oil wells in the Gulf coast section were those of the Mexican Petroleum Company at Ebano, San Luis Potosi. These will have furnished a steady production. But the production was not sufficient to permit the company to fill all of the contracts that were available. Since last August, however, the success of the Huasteca Petroleum Company, one of the allied or auxiliary companies in the field at Juan Casianos, Veracruz, has made the oil properties of that company even more valuable than those of the Mexican Petroleum Comnay at Ebano. Well No. 7, the greatest oil well of the district, is claimed by the company to have a daily production of 28,000 barrels. It is said to be under a pressure of 3000 pounds, and at present to be shut in 50 per cent. Well No. 6, which is claimed by the company to be a 15,000 barrel well is shut in entirely under a 570 pound pressure.

The oil goes through the pipe line from the field at Juan Casiano to Tampico. The largest pipe line delivery in one day up to the present time is 30,000 barrels, but when the storage facilities at Tampico are completed the company expects to pump 32,000 barrels daily. About 20,000 barrels are shipped daily by rail from Tampico. A part of this goes to Ebano to be stored and the remainder to the gas plant in Mexico City.

The greatest problem now confronting this company is that of storage capacity. The storage plans include 24 steel storage tanks each having a capacity or 56,000 barrels. Nine of these have already been completed and it is expected that the remainder will be finished at the rate of five per month. Work has already been commenced on a re-inforced concrete reservoir at Tampico that will hold 1,250,000 barrels. It is said that as soon as possible work will be commenced on another reservoir of the same kind, but having a capacity of only 750,000 barrels, at the Geronimo pipe line station. A third reservoir of the same kind, with a capacity of 500,000 barrels, will be built, according to the plans of the company, about one mile from the Casiano field.

All of this construction work necessitates the purchase of large quantities of supplies. One hundred mule teams and scrapers have been brought in from El Paso, Tex., 22 carloads of lumber have been brought here from the Chihuahua lumber mills, and 75 carloads of machinery have been brought in through El Paso. In addition large quantities of lumber, machinery, oil well supplies, etc., are constantly arriving in Tampico by steamer from the United States, while thousands of barrels of cement have been brought in from Germany.

The company is also preparing to build a 75-mile steam railway from the Ebano fields across its property to the Tuxpam River, at a cost of about $1,000,000 gold. The ties are said to be already on the ground. The company has its own telephone line from Ebano to Juan Casiano and also between Tampico and Casiano. It also has a concession to lay a pipe line under the Panuco River, by which it will be able to deliver oil at the Waters-Pierce tanks at Tampico.

The paving company now has a large force of men working on the streets of Tampico. The streets are being prepared for asphalt and the curbing laid. The company has installed a concrete mixer and an asphalt mixing plant. Most of the machinery comes direct from the United States. Many mules and wagons have also been imported by it for the street work.

The gas plant in Mexico City is said to have a capacity of 1,550,000 feet per day, but it is expected that this will be ultimately increased to 5,000,000 cubic feet per day, in order to meet the demand for lighting and fuel gas.

Another company that has been successful in finding oil in this district is the Aguila Petroleum Company (Pearson & Son). This company is said to have an abundant supply of oil from its wells at Tanguijo and Portreros del Llano, Veracruz, in this district. [It is announced by the Mexican Herald of January 5th that the Pearsons have brought in a new well at Portreros del Llano the flow of which is estimated at 100,000 barrels a day. It is flowing in a great stream

100 feet high and steps are being taken to save the flow and prevent such a conflagration as destroyed the great Dos Bocas gusher.] The company now has three large barges which are used to transport the oil to Tampico. In addition the company is having Captain Hermanson, of the Tampico Navigation Company, build for it six large steel barges to be used for the same purpose. These barges will have a carrying capacity of 1000 barrels each.

This company also has the entire output of the wells of the Oil Fields of Mexico Company, at Furbero, Veracruz, about 55 miles from Tuxpam. This latter company is putting forth every effort to bring in new wells and increase its production. Scores of drillers have been brought to the field from the United States and been put to work drilling wells in the proved oil field. The product is pumped through the pipe line of the company from Furbero to Tuxpam, about 55 miles, from whence it is shipped by steamer to the Pearson refinery at Minatitlan.

All of the companies which had to shut down on account of the rainy season and high water have resumed operations. Several new companies have also commenced work. Among the new companies is the Gulf Coast Oil Company, under the management of Mr. A. H. McKay and Mr. J. E. Mulligan. Mr. Edward Williams has also commenced drilling near Panuco.

A NATIONAL HYDROELECTRIC COMMISSION

The executive committee of the National Electric Light Association recently passed the following resolutions:

Whereas, The condition of the laws and regulations relating to the public lands of the United States Government is so complicated, unsatisfactory and unsettled that the financing and commercial development of new enterprises in connection with public lands is rendered practically impossible; and

Whereas, The immediate development of the idle water powers of the nation is of importance to the whole people in that it brings to immediate use an indestructible natural resource that would be otherwise lost or idle, and conserves coal, oil, gas and other fuels that are limited in amount and not subject to replacement; and

Whereas, The National Electric Light Association is particularly interested in the situation pertaining to public lands of the United States in connection with the development of water powers; and

Whereas, Much of the difference of opinion upon the subject of water-power arises from the difficulty of obtaining a clear comprehension of all the facts; now, therefore, be it

Resolved, That this Association does respectfully urge that a competent commission, composed of members of the Senate and House of Representatives of the United States, together with other persons familiar with the financial and other practical aspects of the situation, be appointed with full authority to collect the evidence, and for that purpose to hold full and complete open hearings in different sections of the country; and be it further

Resolved, That this Association does respectfully urge that such commission be appointed at as early a date as possible to the end that its meetings may be held between the adjournment of the present session of Congress and the reassembling of the new Congress in the hope that such commission should report upon such reassembling and Congress be thereby enabled to take prompt action in the enactment of such laws as will permit the development of the natural resources of the country in such a manner as shall render them of the greatest possible use to all of the people.

CALIFORNIA PUBLIC SERVICE COMMISSION.

The conference measure prepared by Percy Long of San Francisco, providing for a public service commission in California, which is to act, theoretically, at least, until such time as the Constitutional amendment providing for a public utilities commission is adopted by the people, has been introduced in the Assembly by W. A. Sutherland of Fresno and by Senator Burnett in the upper house.

In connection with the bill several other bills to provide for the carrying out of its terms were introduced and also a constitutional amendment giving municipalities, counties or the State the right to award indeterminate franchises to public service corporations and allowing them to take over the franchises.

The bill creates a commission of three, to be appointed by the Governor, who shall draw a salary of $8000 a year each. Under the bill the commission has the power to regulate stock and bond issues and regulate rates outside of incorporated cities. Counsel at $3000 may be employed and a secretary is to be named by the commission, to draw $4200 a year. All public service corporations except railroads will be under the supervision of the commission.

One of the accompanying bills provides that no injunction shall be granted restraining the issuance, sale or offering for sale of any municipal bonds for public improvements or public utilities.

CALIFORNIA CONSERVATION BILLS.

Four conservation bills have been introduced at the California legislature. The most important is that providing for a conservation commission of five members, to be appointed by the Governor, for the purpose of investigating, gathering data and reporting at the next session of the Legislature what legislation is necessary. This commission will gather the facts concerning water sources, water-power, irrigation, reclamation, forestry and mining. The bill appropriates $50,000 for the services of experts and other expenses, the commissioners themselves to work without compensation.

The second bill contains specific regulations as to how water appropriations may be made in the future. It provides for a board of control of three members. Rights already acquired are not to be affected or disturbed. Rights in the future for the use of water to generate electricity and power are not to be granted for a longer period than twenty-five years.

The third bill amends a civil code section to conform with the twenty-five year limitation.

The fourth measure is a constitutional amendment which provides for this limitation and gives the legislative body of a city or county the right to fix [illegible]

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Corona

It has long been a matter of common observation that high-tension electric conductors are encircled by a faint bluish glow at night. This ocular manifestation of high voltage is accompanied by an audible indication, or hissing noise, which has been aptly compared to that of a hive of bees. It was Steinmetz, we believe, who first applied the name "corona" to this phenomena and showed that it was merely a case of disruptive conduction through the surrounding air, which consequently becomes luminous, as does likewise the Geissler tube and the Moore light. Corona has been investigated by many engineers and physicists whose recorded data contained many apparent inconsistencies.

The tremendous task of bringing order out of this chaos has been accomplished in Professor Harris J. Ryan's masterly paper on "Open Atmosphere and Dry Transformer Oil as High Voltage Insulators," presented to the American Institute of Electrical Engineers through the San Francisco Section and briefly abstracted elsewhere in this issue. This paper is a sequel to that presented to the Institute by the same worker in 1904, and like its predecessor, is destined to become a classic. It brings this branch of science to that stage known as the deductive, whence it is but a short step to the final stage of formal development.

The paper is largely devoted to an explanation of corona by means of the ionization theory and to experimental confirmation thereof. According to this theory a thin layer of air around an electric wire contains ions, or electricity carriers, which move rapidly to and fro in the electric field surrounding the wire. Whereas ordinary air is an insulator, air thus ionized becomes a conductor and is made luminous. Corona is thus seen to be the first stage in the breakdown of air as an insulator, succeeding stages being the spark and arc wherein the continuous conduction of the electrode vapor takes the place of the disruptive conduction of the ionized air.

The electronic theory, here employed to such good advantage, is the most promising path toward the solution of the problem as to what is the ultimate nature of electricity. By its means atmospheric electricity, as exemplified in the lightning flash, is found to be due to an electrical charge of the clouds caused by ionization through the ultra-violet rays of the sun. The polar auroras likewise may be traced to the discharge of ionized solar dust into the earth's atmosphere, this dust being deflected to the poles by the earth's magnetic field. So while the theory may be distasteful to the engineer it may yet be the means by which his electrical problems will be overcome.

While these theoretical deductions are of great scientific interest, they are as yet of little practical value. They show the necessity for large conductors and wide spacing in order to reduce the energy loss occasioned by corona. They teach the advisability of keeping the wires clean so as to minimize the number of natural ions which reduce the voltage at which corona may start and they show why these losses are greater at high altitudes where the air density is low. Corona also places a limit beyond which higher voltages are not economical. But for a time, at least, there is little likelihood of corona becoming a crown of thorns to the transmission engineer.

PERSONALS.

C. R. Ray, manager of the electric light and power system at Medford, Ore., was a recent San Francisco visitor.

Leon Bly, secretary of the Tehama Light & Power Company of Red Bluff, was a recent San Francisco visitor.

T. E. Bibbins of the General Electric Company, is seeking health and taking a much needed rest at Honolulu.

W. S. Heger, California manager of the Allis-Chalmers Company, spent the past week in Los Angeles and vicinity.

H. E. Adams, general manager of the Stockton Gas & Electric Company of Stockton, recently spent a few days at San Francisco.

E. L. Haines, of J. G. White & Co.'s San Francisco staff, who was confined to a hospital by illness for several weeks, is now convalescent.

H. Carl Strong, general manager of the Ketchikan Light & Power Company, arrived at San Francisco last week from Ketchikan, Alaska.

H. R. Noack, manager of Pierson, Roeding & Co., recently returned to his San Francisco office after completing a tour of the Pacific Northwest.

A. J. Myers, Pacific Coast district manager for the Wagner Electric Manufacturing Company, is visiting the company's factory at St. Louis.

J. A. Cranston of Portland, who has extensive hydroelectric power interests in the Pacific Northwest, arrived at San Francisco last Monday.

F. A. Burnham, superintendent of the Tonopah Water Company, left for Carson, Nev., last Sunday after spending a few days at San Francisco.

H. C. Keyes, of the Sacramento Natural Gas Company, of Sacramento, spent last Sunday in San Francisco with his bride on a honeymoon tour.

R. L. Van der Naillen, superintendent of the Oro Water, Light & Power Company's hydroelectric plant, was a recent San Francisco arrival from Oroville.

W. J. Stadelman has resigned as manager of the Santa Monica Bay Home Telephone Company of Santa Monica, Cal., being succeeded by L. R. Weaver, formerly of Richmond, Ind.

G. C. Townsend has resigned as manager of the Butte exchange of the Rocky Mountain Bell Telephone Company to represent the National Packing Company at Billings, Montana

John Boulware Bubb was the only midwinter graduate in the mechanical engineering department at Stanford University out of the sixty-three students who were recently granted degrees at that institution.

Thomas Mirk, of Hunt, Mirk & Co., left during the past week for San Diego, where the firm are installing additinal Westinghouse-Parsons turbines and condensing apparatus for the San Diego Electric Railway Company.

Wynn Meredith, Pacific Coast manager for Sanderson & Porter, the New York firm of electrical engineers, has gone to Victoria, B. C., on business connected with the Jordan river development of the British Columbia Railway & Power Company.

Four of the Western Union Telegraph Company's officials arrived at San Francisco last Sunday to confer with C. H. Gaunt, the general superintendent of the Pacific division, who is convalescent after a severe illness. They are: E. Boening, district commercial superintendent at Seattle; W. J. Smith, commercial agent in the same district; Hugh McPhee, district commercial superintendent at Los Angeles, and C. E. Van Landingham, commercial agent.

George R. Field, assistant general manager of the Great Western Power Company, made a trip covering the hydroelectric transmission lines of the system in the valleys between the generating plant and San Francisco during the past week.

D. C. Henny, a United States Government engineer connected with the Reclamation Service with headquarters at Portland, has arrived at San Francisco in company with E. J. Hopson for the purpose of letting contracts for work on the Truckee-Carson project in Nevada.

H. A. Lardner, manager of the Pacific Coast branch of J. G. White & Co. of New York, left last Monday for Los Angeles, where he expected to meet E. G. Williams, the firm's general superintendent of construction, and make an inspection of the work in progress in Southern California.

W. H. Phillips is chief engineer of the modern electric power plant, in the new eight-story building of the Young Men's Christian Association on Golden Gate avenue, which was recently constructed at a cost of more than $600,000. He was formerly connected with the United States Navy and was also a chief engineer of U. S. Army transports. Raymond P. Perkins, who was formerly connected with the power plant at the Presidio, is first assistant engineer and F. D. Rees is the second assistant.

TRADE NOTES.

The Fort Wayne Electric Works have the contract for the second of series of haulage engines for scraping gravel to the Grant Gravel Company, to be used in their gravel pits at Pleasanton, consisting of 125 h.p. motor, 2200 volts, direct geared to No. 6½ steel frame Hendrie Bolthoff hoist.

Smith, Emery & Company, engineers and chemists, announce a re-organization of their business, made necessary by its rapid growth and development. The capital stock has been increased to $100,000, and the latest bookkeeping and filing systems are being installed. The Los Angeles establishment, which has hitherto been a separate corporation, under the name of Smith-Emery Company, now becomes a part of Smith, Emery & Company, the parent organization. The laboratories and offices of the company occupy the entire building at 651-3 Howard street, San Francisco, and the Los Angeles branch occupies the entire building and lot, owned by the company, at 245 So. Los Angeles street, in that city. The firm has at present on its regular staff twenty-two engineers, chemists, and assistants, and a staff of six associate engineers, and has extensive Eastern, Canadian and European connections.

NEW CATALOGUES.

The Electric Storage Battery Company has issued an interesting bulletin of facts concerning the new "Ironclad Exide" battery for electric vehicles.

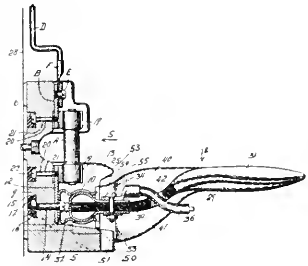
Bulletin No. 130 from the Electric Storage Battery Company is devoted to the installation of the "Chloride Accumulator" for the Slate Belt Electric Street Railway Company of Pen Argyl, Pa.

Catalogue No. 115 from the Hooven, Owens, Rentschler Company, Hamilton, O., is devoted to series N Hamilton power pumps, belt or rope driven from engine, motor or line shaft. Chas. C. Moore & Co., engineers, are general Pacific Coast representatives.

Boiler Tube Cleaners are listed in a 48-page 5x7 in. catalogue from the Lagonda Mfg. Co., Springfield, O., devoted to Weinland tube cleaners, both water and air driven, turbine cleaners, ball and thrust bearing type and quick repair heads. Chas. C. Moore & Co., engineers, are general Pacific Coast representatives.

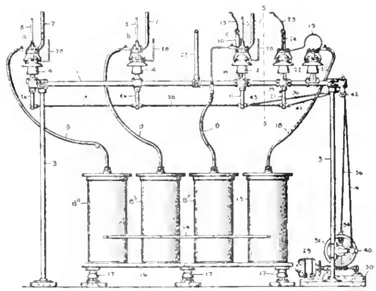
PATENTS

981,622. **Electric-Vehicle-Charging Wall-Socket and Plug.** Jasper Newton Davis, Denver, Colo. In an apparatus of the class described the combination of a socket block whose body portion is composed of insulating material, said block being equipped with socket contacts and a co-operating socket plug provided with electrodes adapted to engage the contacts of the block, and electrical conductors connected with the respective electrodes, the body of the plug being



composed of insulating material and having a handle offset therefrom, the body portion having separated perforations formed at a point below the angle of the handle through which the said conductors pass, the plug being also equipped with upper and lower webs forming barriers between the conductors, and their respective contacts and electrodes, the said webs being interposed between the perforations, substantially as described.

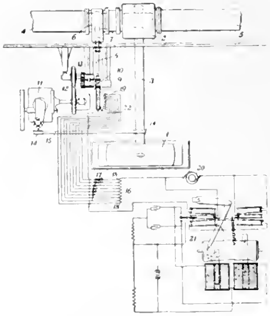
982,224. **Lightning-Arrester.** Elmer E. F. Creighton, Schenectady, N. Y., assignor to General Electric Company. The combination with a three-phase system having three conductors, of four electrolytic condensers with correspond-



ing terminals electrically connected and the other terminals of two of said condensers directly connected to two of said conductors, and means whereby either of the remaining two condensers may be connected to ground and the other connected to the third conductor.

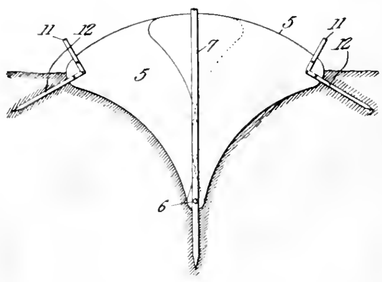
981,881. **Electrical Motor.** Harry A. Rhodes, Denver, Colo., assignor to The Universal Motor Company, Denver, Colo. An electric motor, comprising a rotatable member provided with a series of electro magnets, a commutator whose segments are respectively connected with the coils of the said magnets, positive and negative brushes engaging the commutator, and a stationary armature member eccentrically arranged adjacent to the magnets, means for varying the air gap between the armature and the magnets, the parts being so arranged that the magnets are energized on the approaching side of the shortest air gap, between the magnets and the armature member, substantially as described.

981,789. **Fluid-Measuring Device.** Samuel L. Nicholson, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. The combination with a fluid-propelled prime mover, a throttle, valve or gate, a rack operatively connected to the gate, and a governor for automatically varying the valve or gate opening according as the speed



of the prime mover varies, a resistance having a plurality of intermediate taps severally connected to a series of stationary contact members, a movable engaging contact member secured to the rack, and a source of energy for the resistance, of an electric measuring instrument for continuously recording the energy consumed in the active portion of the resistance.

981,849. **Portable Dam.** Ethan A. Ernst, Lamar, Colo., assignor of one-third to William E. Nogal and one-third to William S. Holbert, Lamar, Colo. A portable dam comprising pivotally connected wings swinging transversely of the ditch, and a support carrying said wings, said support comprising a rod extending in front of the wings, and projecting



below the same, the projecting end of the rod being adapted to be inserted into the bottom of the ditch, and the upper end of the rod extending in a bend across the top edges of the wings, and downwardly behind the same, the pivot of the wings being carried by said front and rear portions of the rod, and the wings being located therebetween.

INDUSTRIAL

SWITCHBOARDS FOR JAPAN.

BY EMIL BERN.

Two switchboards of considerable size have lately been built by the General Electric Company of Schenectady, New York, for the Koyoto Municipal Water Works, Japan.

The generating station board is shown in Fig. 1 It is forty feet long and consists of twenty-four three-section marble panels, supported on a pipe framework. This framework also carries the oil switches, disconnecting switches, instrument transformers and several sets of busses.

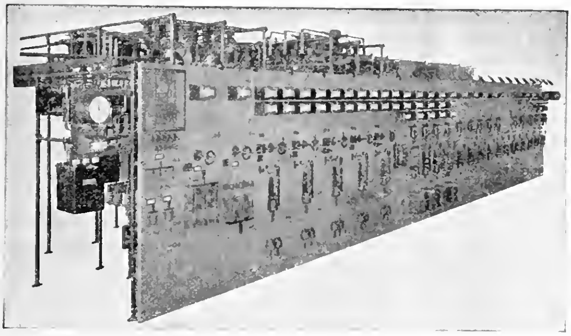


Fig. 1. 6600 and 35,000 Volt Switchboards for Municipal Water Works, Kyoto, Japan.

The station equipment controlled from this board consists of: Two turbo exciters, 125 volts, 125 kilowatt; five 3-phase turbo generators, 6600 volt 1500 kilowatt, 60 cycles; three 3-phase outgoing lines, 6600 volts, to substation; one bank of transformers 6600/3500 volt; seven 3-phase feeders, 3500 volt; three 3-phase, 4-wire feeders, 3500 volt.

Each exciter has a triple pole, double-throw switch and a double set of busses so arranged that either exciter can be used to excite the generator fields, while the other is used for station lighting and auxiliary power.

The alternating current generator panels, in addition to the usual instrument and synchronizing equipment, have reverse current relays for automatically tripping the oil switches on a reversal of current which might result from a short

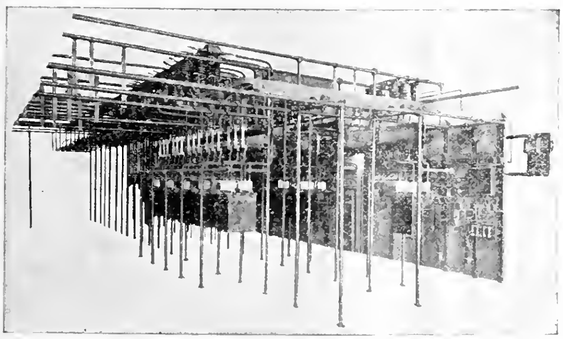


Fig. 2. Arrangement of Switching Apparatus for Municipal Water Works, Kyoto, Japan.

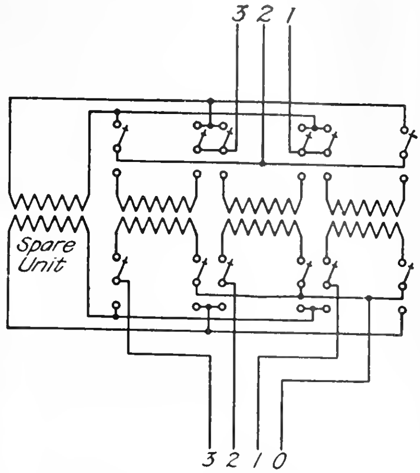


Fig. 3. Diagramatic Representation of Transformer Connections and Method of Cutting in Spare Units.

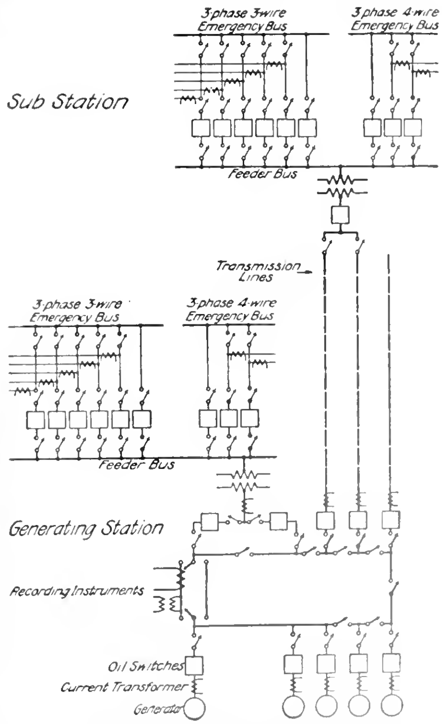


Fig. 4. Diagramatic Representation in Generating Station and Substation Wiring.

circuit in the winding of the generator or from a failure of the prime mover.

The panels controlling the different lines and feeder circuits are equipped with inverse time limit overload relays in connection with automatic oil switches in addition to the indicating instruments.

Continuity of service was considered of primary importance in the design of this switchboard and to insure this, an arrangement of spare equipment, as illustrated in Fig. 3, was adopted. For the transformer bank consisting of three 750 kilowatt single phase units, one spare transformer of the same capacity was installed to take the place of any disabled unit. These four transformers are connected through transfer switches on the primary and secondary sides to enable the operator to disconnect any unit and connect the spare for service in the shortest possible time.

Spare oil switches for both the three-phase, three-wire and the three-phase, four-wire feeder systems connect the main feeder bus with a set of emergency busses to which any feeder circuit can be connected through transfer switches. The feeder oil switches are provided with disconnecting switches on each side and can be taken out of service for inspection and cleaning without interrupting the circuit. Fig. 4 shows this arrangement. This illustration also shows clearly the ring bus system used, by which certain groups of feeders may be connected to different generators independent of other groups or the whole system operated together.

THE "IRONCLAD-EXIDE" BATTERY.[1]

BY BRUCE FORD.

The "Ironclad-Exide" battery is of the lead sulphuric acid type, and its principal feature of novelty resides in the construction of the positive plate, together with other features of mounting and connecting, which will be brought out later. The flat plate form was many years ago recognized as the best electrode for both positive and negative plates. Two forms of design have been in vogue for many years—the plain plate or slab, and plate composed of a number of parallel bars or rods laid side by side and mounted in a suitable frame. Where the latter design has been employed, it has usually been for the positive electrode or pole plate. This has been true in both the lead sulphuric acid type of battery and also in the alkaline battery.

The new "Ironclad" positive plate is of this design. Its grid is composed of a number of parallel vertical metal rods, united at their tops and bottoms integrally to top and bottom frames, the top being supplied with the usual conducting lug. Each vertical rod forms a core surrounded by a cylindical pencil of peroxide of lead active material, which in its turn is enclosed by a hard rubber tube supplied with a multiplicity of fine horizontal laminations to provide access for the electrolyte to the active material, and passages for the flow of current during the charge and discharge of the plate. The rubber tube fits very snugly upon the active material, and its elasticity allows a certain come and go, maintaining its relation with respect to the active material during the alternate expansion and contraction of the latter in the process of charge and dischaige.

The cylindrical form is peculiarly adapted to perform this function, and the amount of electrolyte surrounding each tube is just about the correct proportion for the active pencil. Each rubber tube is furnished with two oppositely disposed vertical ribs, which serve to stiffen and strengthen the laminated tube and act as separators, entirely taking the place of

The negative plate is of the form used successfully for the ribs commonly provided upon the separators of cells using plain flat plates.

[1] Abstract of paper presented at the meeting of The Electric Vehicle Association of America, New York, January 17, 1911.

so many years in the "Exide" Battery, but in order to enable it to withstand not only the increased capacity, but also the greatly increased life of the new "Ironclad-Exide" positive plate, it has been made somewhat thicker.

The grid of the negative plate is of the standard "Exide" design, facial horizontal bars on one face of the plate being in staggered relation to the bars on the opposite face, the whole, being united by vertical ribs at intervals.

The wood separator, consisting of a plain sheet of veneer of appropriate thickness, is interposed between the face of the negative plate and the vertical ribs of the rubber tubes of the positive plate.

The positive and negative plates respectively are united into groups, their lugs being burned to pillar straps in the ordinary way.

An improvement on the pillar strap has been incorporated for the "Ironclad-Exide" Battery, by slightly pointing the tops of the pillars, thereby making it somewhat easier and quicker to burn the connections. This modification is also being incorporated in the straps for standard "Exide" cells.

The connector used in the "Ironclad" Battery is not rigid, as it is in the "Exide" Battery, but is made of thin sheets of copper lead plated to protect the copper against corrosion, and provided with an alloy terminal at each end received to receive the pillar of the strap, to which it is integrally burned.

A battery assembled with these connecters has a very neat and business-like appearance.

The characteristics of the cell in discharge are similar to those of other types of lead storage batteries, the potential at the normal four-hour rate starting well above two volts and maintaining a fairly uniform value throughout the discharge until toward the end, when it drops more rapidly. At 1.75 volts, the cell is practically discharged.

Similarly its characteristics during charge are like those of other lead batteries, the voltage remaining fairly uniform throughout the major part of the charge and rising rapidly to its final value toward the completion of the charge.

The internal resistance of the cell, being about the same as that of an "Exide" cell of corresponding size, the variation in capacity with change in rate is about the same. While its capacity decreases at a less than constant rate of change with increase of discharge rate, yet its capacity becomes greater at an increasing rate as the discharge rate becomes less. This is a valuable characteristic of the lead cell when the elapsed time of discharge is extended.

The new battery is rated initially at four and a half hours at a current corresponding to the four hour rate of an "Exide" Battery of the same size. For example, an MV "Ironclad" positive plate is rated at 7 amperes for four and a half hours. As the battery is worked, the capacity will increase to from five and a half to six hours or even more. Cases have been recorded under somewhat special conditions where the capacity has reached seven hours at this rate before beginning to decrease.

The gain in capacity is not merely temporary, and although increasing at a comparatively rapid rate it decreases very slowly so that the actual capacity is considerably above the rating for practically the entire life of the plates.

The dimensions of the elements of the new battery were proportioned to make "Ironclad-Exide" elements interchangeable with those of the "Exide," so that plates from an "Exide" Battery can be renewed with a proper fitting element of the "Ironclad-Exide" type. This has been accomplished by making the new plates in both MV and PV sizes, and of appropriate thickness to be mounted upon the same plate center spacing as that of the "Exide." Since the outside negatives in the "Ironclad" are of the same thickness as the negatives of the "Exide" Battery, the over all dimensions of an "Ironclad" element are therefore the same as the over all dimensions of an "Exide" element having the same number of plates.

NEWS NOTES

FINANCIAL.

EUGENE, ORE.—The Council has taken steps to install a municipal lighting system and the matter will be presented to the voters at the April election.

VENICE, CAL.—A bond election will be held in the near future to vote on the proposition of issuing and selling bonds for an extension of the salt water mains.

FALLS CITY, ORE.—At the special election held in Falls City last week the proposition to issue city bonds to the amount of $25,000 for installing a water system was carried by a vote of 148 to 21.

HOOD RIVER, ORE.—A special city election will be held here for the purpose of submitting to the voters the question of an issue of bonds in the sum of $38,900 for the purpose of purchasing the water plant and the distributing system used by the Hood River Light & Power Company.

ANAHEIM, CAL.—The City Council passed an ordinance providing for holding a special election on January 30th to vote on issuing bonds in the sum of $90,000 for the construction of a sewer system and $85,000 for the acquisition of certain electric light appliances and additions to the municipal light and water works building. The bonds will bear 5 per cent interest per annum payable semi-annually.

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Leitch Electric Company has been incorporated by Chas. A. Leitch, Warren Vance and D. A. Turnbull, with a capital stock of $25,000.

SAN FRANCISCO, CAL.—The Sierra-Blue Lakes Water & Power Company has been incorporated by Eugene J. Sullivan, Walter E. Sullivan and Geo. H. Richardson, with a capital stock of $75,000.

SAN FRANCISCO, CAL.—The Sacramento Short Line has been incorporated by B. M. Aikins, R. P. Henshall, Luther Elkins, G. W. Mordecar, R. V. Whiting, M. Schmulo and F. L. Stewart, with a capital stock of $10,000,000.

VANCOUVER, WASH.—The Northwestern Electric Company, capital $5,000,000, has been incorporated by D. A. De Yarmon of this place, B. C. Condit of Oakland, Cal.; C. E. S. Wood, N. E. Parker and Erskine Wood of Portland. The new company proposes to develop power on the Lewis river.

SEWARD, ALASKA.—A. C. Brown and other citizens of this place have organized the Seward Alaska Electric Company, capitalized at $200,000 for the purpose of the construction of a telephone line from this place to mining camps on Cache creek and later to Iditarod. Orders for wire and equipment have been placed.

ILLUMINATION.

FULLERTON, CAL.—R. C. Keen of Monrovia has completed arrangements for an electric store in Fullerton.

COTTAGE GROVE, ORE.—The Cottage Grove Light & Power Company has been granted a 25-year franchise.

ORLAND, CAL.—C. R. Wickes has been granted a franchise for an electric light and power plant here. Work on it is expected to commence within two months.

EUGENE, ORE.—Preliminary steps are being taken by the City Council toward establishing a municipal light plant, the current from the city's power plant at Waterville to be used.

ANAHEIM, CAL.—The city of Anaheim has let a contract to Mr. Orr to erect reinforced concrete electric poles on the Broadway extension at 35c per lineal foot.

EL CENTRO, CAL.—The Holton Power Company will at once erect a large gas plant here and has let a contract to Allis-Chalmers Company for a gas producer plant. The plant will cost $250,000.

METALINE, WASH.—W. W. Warmer, representing the Sterling Silver Lead Company, has been granted a franchise to operate a telephone and electric power system and to construct a system of water-works here.

KLAMATH FALLS, ORE.—Mayor Sanderson is in receipt of a communication from the Rogue River Valley Gas Company inquiring as to the possibility of securing a franchise for the establishment of a gas plant here.

BENSON, ARIZ.—A franchise has been granted R. G. Arthur for an electric light power plant at Benson. A company will be incorporated shortly with M. J. Cunningham, S. F. Meguire, W. M. Adamson and Pete Jensen.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the City Electric Company the following directors were elected: Mortimer Fleishhacker, Herbert Fleishhacker, L. Schwabacher, W. Arnstein, S. L. Napthaly, Wm. L. Gerstle, J. J. Mack, S. Scheeline and A. Schwabacher.

SEATTLE, WASH.—The Board of Public Works has passed favorably upon the project for the construction of a 2000 h.p. hydroelectric plant on Lake Union, utilizing the waste water system. A large storage reservoir will probably be constructed in Volunteer park and a steel pipe will be installed to conduct water to the plant.

ROSWELL, ARIZ.—The Berrendo Irrigated Farms Company which bought the Roswell Electric Light & Power Company's plant last year, is preparing to spend $250,000 in a new building and additional machinery and equipment to furnish power for pumping water for irrigation and for a street and suburban railway that is to run from St. Mary's Hospital on the Milne Bush tract.

MONTEREY, MEXICO.—Tenders will be received by the Monterey Railway, Light & Power Company of Monterey, Mex., up to March 1st, 1911, at the office of the company, for the erection of a gas plant to serve the requirements of Monterey, Mexico, a city of 85,000 inhabitants, with first class railroad facilities. Plans and specifications may be seen at the company's offices. Copies of plans and specifications, form of tender and other necessary information will be furnished to responsible bidders on request. Separate or supplemental tenders will also be received at the same time for the laying of gas mains and curb connections. All interested parties should communicate with Vice-President Lewis Lukes, Monterey Railway, Light & Power Company, Ltd., Apartado P. O. Box 58, Monterey, N. L., Mexico.

TRANSMISSION.

EUGENE, ORE.—It is reported that the Oregon Power Company will soon begin work on the construction of the proposed electric plant at Martins Rapids.

REDDING, CAL.—A water right claiming 250,000 inches in the Sacramento River at a point three miles north of Redding has been located by Geo. L. Bancroft, of Denver, Colo. Bancroft is a civil engineer. The location is the largest ever made in Shasta County. The notices are posted on the east bank of the river a little below Middle Creek station. The

location of the water right was made this week by George W. Bush, attorney for Mr. Bancroft, in obedience to telegraphic orders received from Denver. The Sacramento Valley proper begins at Middle Creek, three miles above Redding. It is there that the canyon walls recede and the farming land appears.

TRANSPORTATION.

GREAT FALLS, MONT.—Fire recently destroyed the car barns of the Great Falls Electric Company, causing a loss of $20,000.

MEDFORD, ORE.—Dr. J. F. Eddy has applied for a franchise to construct an interurban trolley line here in the interest of outside parties.

VALDEZ, ALASKA.—It is reported that the construction of an electric railway six miles long from this place to Mineral Creek will soon be under way.

BUTTE, MONT.—The Butte Driving Club is preparing to build a street railway line from Reagan's roadhouse on the flat to the Five-Mile, in case the street railway company does not take action.

OAKLAND, CAL.—The East Shore and Suburban Railway Company between Richmond in Contra Costa County and Oakland and other cities in Alameda County, was acquired last week by the United Properties Company, recently formed, with F. M. Smith as one of the leading factors.

SACRAMENTO, CAL.—Street-car transfers are to be good at any time during the day of their issuance if a measuse introduced in the Assembly by R. J. Callaghan of Alameda becomes a law. The bill provides that every transfer issued by a street railway company shall be honored by the conductor of the line for which the transfer is issued at any time during the same day that it is issued.

HOOD RIVER, ORE.—The principals of the electric road to connect Hood River with the North Bank road have been looking over the situation. The proposition roughly outlined is to run a track from Bingen to the Columbia River, crossing the river by ferry at the Koberg lock and then follow the county road into Hood River, connecting with the Hood River electric road, which is said to be a sure go in the spring.

WATER-WORKS.

REDMOND, ORE.—Redmond is to have a $10,000 water system.

CENTRALIA, WASH.—The City Council of Centralia plans to acquire a city water system to cost $200,000.

ASOTIN, WASH.—Engineer Foster of the Lewiston-Clarkston Company, is now engaged in surveying the town in order to make plans for the installation of a system of water-works.

OREGON CITY, ORE.—Willamette has sold $3600 worth of bonds to the First National Bank of this city. The sale insures an early beginning of the work of installing a complete water system.

SALINAS, CAL.—General Manager W. H. P. Hill of the Monterey Gas & Electric Company has applied for permission to string the 8-inch water pipe to take the place of the old mains in the water service, along Main street through this town.

RICHVALE, CAL.—Sealed bids will be received by the secretary of the Richvale Land Company up to 12 o'clock noon of February 6th, 1911, both for material used, in labor performed on and construction complete of the sewer system, septic tank, water system and cement walks for and in the townsite of Richvale.

ANAHEIM, CAL.—Six bids were received by the Council for laying a water pipe line on Broadway between Los Angeles and Walnut avenues. W. L. Kreuscher secured the contract for $589.67.

FRESNO, CAL.—The August Oil Company, operating in the Midway field in Kern County, will begin at once the laying of water pipe lines from their property to other portions of the field. At a meeting of the directors of the company held in this city, the work of laying a 4-inch water pipe line to a point 2½ miles northwest and to another point one mile east of the August property, was authorized. The August property is located on section 31. It is proposed to continue the line to the east, two miles south and east to the center of the Maricopa field.

SAN FRANCISCO, CAL.—According to an estimate made by G. A. Elliott, superintendent of maintenance for the Spring Valley Water Company, the recent storm has stored up in the company's reservoirs enough water to supply San Francisco for the next two years. Over 2,164,000,000 gallons of water has been added to the company's supply for future use in San Francisco. At Crystal Springs where the reservoir is ten miles long, the storm was most bounteous. The water in the reservoir, which daily supplies 5,000,000 gallons to the city, rose nearly two feet and increased the available supply of 1,624,000,000 gallons, making a total of available supply of 17,650,000,000 gallons. More than 400,000,000 gallons were poured into the San Andreas during the week. The total available supply of water in San Andreas reservoir was increased to 4,118,000,000 gallons during that period. Pilarcitos reservoir had an increase in the water supply during the week of 140,000,000 gallons, making the total available supply 326,000,000 gallons.

SAN FRANCISCO, CAL.—Affirming its decision of a year and a half ago in practically the same measures, the Supreme Court last week gave a victory to the city of Oakland over the Contra Costa Water Company, reversing the decision of the Alameda Superior Court and granting the city a new trial in the long legal battle over rates fixed by the City Council. In its original opinion the Supreme Court implied that the properties of the water company were not worth more than $3,500,000, and that a net return of 4½ per cent upon the investment was a fair and reasonable rate to allow a public service corporation. Last week the court undertook to explain that it did not mean to imply anything of the kind. With regard to the valuation of the properties the court said first, that the $7,000,000 figure set by the trial court was entirely unsupported by evidence, and second, "No value in excess of $3,000,000 being admitted by the pleadings, and there being evidence supporting a finding of value as low as $3,500,000, we were constrained to deal with the appeal, in the absence of a finding of value sufficiently supported by evidence on the theory that the value was no greater than the lowest amount as to which a finding would have been held to have been supported by the evidence contained in the record; that amount was practically declared to be $3,500,000." As to the rate, the court said: "We were not to be understood as intimating that such a return would be considered a fair and full return under all the circumstances were we a legislative body empowered to fix rates. But to be declared confiscatory the return must give less than the lowest reasonable percentage of profit upon the actual value of the property devoted to the public use." In other words, the court found that the rates as fixed by the city of Oakland could not be held confiscatory, even if they were not quite fair and reasonable. In its original opinion the court, referring to a net return to the stockholders of 4.68 per cent, said: "This certainly would be a very substantial net return, considerably more than is desired from many investments eagerly sought by capital."

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JHELUM HYDROELECTRIC POWER PLANT[1]

BY HEINRICH HOMBERGER.

The beautiful valley of Kashmir, India, of which Srinagar is the capital, with its colony of houseboats, lies 6000 ft. above the level of the sea, the mountain Haramukh (16,903 ft.) guarding the valley of the Sind, while at a farther distance rises the sacred mountain Mahadeo.

Kashmir was once a lake, and it sometimes suffers now from terrible floods, receiving as it does the rainfall of 3900 square miles and having but one outlet, the gorge of Baramulla to the river Jhelum—the Hydaspes of Alexaner the Great. Wular Lake, which is 12½ miles by 5 miles in extent, is said to flow over the remains of a city famed for its wickedness, which was destroyed by earthquake and flood. The boatmen plying on the lake say that the ruins have been seen in the water. Maharaja Sir Pertab Singh holds sway over a territory of 88,000 square miles, some of which is amongst the most fertile in the world, peopled by about three millions. Himself ranking as one of the foremost Hindu princes in India, more than half the population over which he rules is Mohammedan.

Fig. 1. Intake near Baniar. Regulating Basin, Main Sluices, Grid Barrier and Floating Timber Booms.

In 1905 the maharaja was granted fuller independent power of administration by the supreme government of India, and Kashmir bears witness to the wisdom and sense of proportion exercised in its use.

The ruler of Kashmir has applied his knowledge of science, as well as of medicine and law, to the government of the country, and Kashmir is now opened out by a railway system which is to be entirely operated by electricity. The latest and no doubt the largest public-works undertaking just completed in Kashmir is the Jhelum electric power installation.

The report and recommendation of Major de Lotbiniere, R.E., C.I.E.,—by whom the preliminary investigations and reconnaissance survey of the works were completed in 1904,—having been finally accepted by the durbar of Kashmir, it was decided to commence construction in the spring of the following year. The report had located the site of the head works nearly opposite the ancient temple at Baniar, 85 miles on the Jhelum Valley highway, with forebay and power house at Mohora, about 6½ miles farther down, the available working head being approximately 400 ft. The Jhelum Power Division was formed without delay, with headquarters at Baniar, where the old state sawmill buildings and road bungalow were placed at the disposal of the electrical department by the state engineer, which afforded, after some alterations and renovations, suitable accommodation for the resident engineer, divisional office, store and office establishment.

These buildings were subsequently transferred formally, at a valuation arrived at by mutual agreement. By the latter end of May, most of the land required had been taken up and demarcated, and contracts allotted on open tender for the construction of head works, and upper sections of the supply channel, ground being first broken on the 26th of that month, near the head works. Meanwhile, check levels had been taken from the proposed site of the head works to those of the forebay and power house, and the accuracy of the preliminary work in this connection was fully established. Careful and detailed inspection of the supply

[1] Abstract of paper presented to the Technical Society of the Pacific Coast and reprinted from the Journal of the Association of Engineering Societies.

channel alignment along the hillsides showed that a wooden flume presented the only practicable method of conveying the water required over the greater part of the 6½ mile route. The state forest department having undertaken the supply of the whole of the timber (deodar) required, then estimated at 300,000 cu. ft., and details having been settled, indents and full information in this connection were promptly submitted to the conservator of forests. Major de Lotbiniere, C.I.E., left Kashmir for Europe and America on deputation at the beginning of July, 1905, to arrange preliminaries, contracts for the hydraulic and electric plant, and also for plant and machinery required in connection with the proposed dredging operations. Major H. A. D. Fraser, R.E., was appointed as engineer and agent in London to the Kashmir durbar in connection with the Jhelum power installation in June, 1906. Mr. A. C. Jewett was appointed in this capacity from December, 1906, and was located at the Schenectady works of the General Electric Company, New York, whose tender for electrical plant had been meanwhile accepted

Fig. 2. Intake. Detail of Grid Barrier.

The Development of Water-Power.

The present works, in so far as they relate to the development of water-power, have been constructed to develop 20,000 h.p. at Mohora, of which but 5300 will be utilized at present, the generating plant comprising 4 units only, each of 1000 kw. The site for the head works was fixed finally at a point some 500 ft. above that originally selected, gaining thereby an additional head of about 10 ft., and reducing the excavation on the channel line considerably. The general design is very much like that usually adopted for the head work of an ordinary irrigation canal. It consists of a draft or intake channel, regulating basin and scour sluice, the latter having four outlets, each 4 ft. by 7 ft., with the sill level 2 ft. below that of the lower main sluices.

Of main sluices there are ten, in two tiers, one above the other, for use at high and low river level. These discharge into a small regulating basin, at the contracted end of which a gate 8 ft. wide and 9 ft. high gives admittance to the supply channel. These gates are all of steel, and provided with suitable screw gearing for manipulation. All outlets are protected by heavy iron gratings. A vertical grid-barrier of old rails, erected vertically across the intake channel, together with massive floating timber booms securely anchored, afford further protection from damage by passing timber, vast quantities of which are floated down the river each flood season by the state forest department. The capacity of the main sluices is over 600 cu. ft. per second, with minimum head at low water. During construction a temporary bund was thrown around the site to exclude the river, and constant pumping operations were necessitated during the whole of the working season of 1906, at the end of which the works had been brought well above high flood level. The masonry throughout is of gneiss bowlder stone, obtained near the site, in soorkhee mortar, Portland cement being used in both concrete and masonry of foundations.

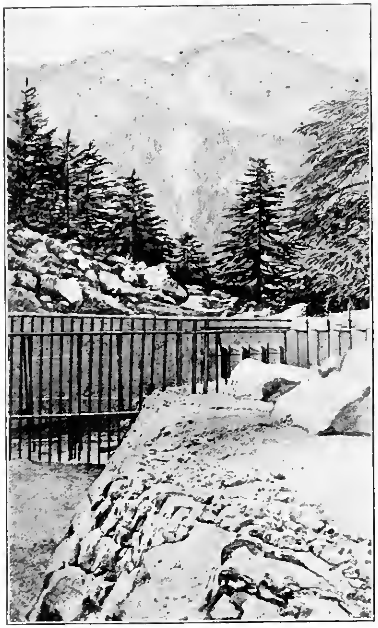


Fig. 3. Masonry-Lined Conduit; in Background the Arched-Over Type of Conduit in "Cut and Cover."

Masonry Conduit.

The supply channel takes the form of a masonry lined and floored conduit, and wooden flume; the lat-

ter construction was resorted to only when the former was found impracticable.

The total length of channel is 6.5 miles, made up of

	Miles.
Masonry lined conduit	1.57
Silt basin	0.11
Wooden flume	4.67
Rock tunnel, unlined	0.15
Total length	6.50

A masonry lining was inevitable, owing to the nature of the soil, loose shingle, bowlders, and silt, in irregular formation. The thickness of masonry lining averages 2 ft., with backfilling of clay concrete; that of the floor being 6 in., all sub-laid with soorkhee concrete of 6 in. minimum thickness. The whole is of coursed stone rubble in soorkhee mortar, and the water-bearing surfaces are pointed throughout with Portland cement. The dimensions of the masonry duct are 11 ft. wide and 9 ft. minimum height, the section is rectangular, with a uniform grade of 1.05 per 1000, this being constant from head works to forebay. The aggregate length of the masonry conduit is 8300 ft., of which 3200 ft. are arched over in "cut and cover." The locations of this type of channel are as follows:

From the head works to the Baniar stream, length of 3400 ft., of which 1000 ft. (chains 7 to 17) lie in very deep cutting, the arched roof being superlaid with earth cover to a depth of from 10 ft. to 20 ft. From the left bank of the Baniar stream to the head of the silt basin there are 450 ft. of cut and cover, with 400 ft. of similar construction below the basin, and 153 ft. of ordinary channel. At Rampur, the masonry conduit recommences at chain 73, in continuation of an interpolated section of wooden flume, passes beneath the Jhelum Valley Road, and across the camping ground of His Highness the Maharaja Sahib to chain 91, being at either end about 1000 ft. long; just below Rampur, chains 102 to 107, the channel forms a subway on a reverse curve, below the bed of a large and at times dangerous nullah. A similar subway passes beneath the bed of a nullah at Chenanwari (chain 257), followed by 150 ft. of arched conduit in cut and cover, and about 200 ft. of open masonry channel immediately beyond tunnel No. 3, at Chenanwari. From the lower end of tunnel No. 6, the masonry conduit runs across the flats of Mohora plateau, for a length of about 13,000 ft., where it debouches into the forebay; this last section is lined and floored in brickwork.

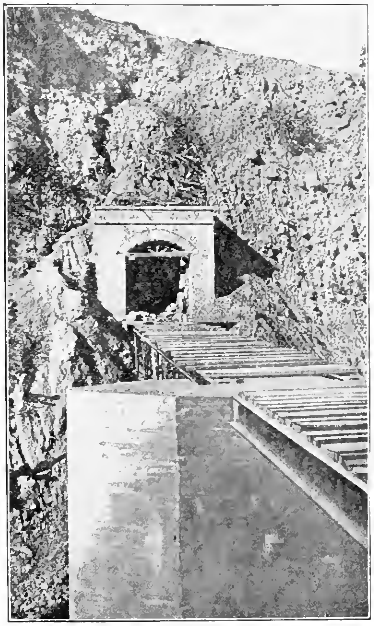


Fig. 4. Tunnel No. 3 Near Chenanwari, and Aqueduct Crossing Gorge.

Fig. 5. Flume in Course of Construction. Dry-Laid Retaining Wall.

The Wooden Flume.

It was, as already stated, decided at the outset that a wooden flume presented the only practicable method of conveying the water along the steep hillsides, which are of loose formation generally with side slopes ranging from 1 in 2 to 1 in 1, and averaging 1 in 1 1/3. A woodworking plant was imported and installed with two portable engines in a temporary mill at Rampur where the whole of the tongued and grooved planking, etc., for floor and side lining (over one million linear feet) and other miscellaneous work, were dealt with. The rectangular flume frames were all worked up by hand at site. Final alignment having been demarcated, it was decided that the track on which the flume was to be built should take somewhat

the form of an ordinary hill roadway with a uniform grade of 1.05 in 1000. A continuous retaining wall of coursed rubble laid dry, battered 1 in 4 to 1 in 3, supports the hillsides, and a drop wall of similar construction protects the outer edge of the track from erosion, etc. The minimum width of the track is 12 ft. and it is metaled throughout. The dimensions of the rectangular wooden flume are, 8 ft. 4 in. wide and 8 ft. 6 in. between floor and under sides of caps; these are canted at the outer ends in rounding sharp curves to counteract centrifugal wave effect. The minimum radius of curvature on the line is 50 ft., and these curves occur at three points only, viz., Baniar aqueduct, entry to tunnel No. 2, and at No. 6 aqueduct over the Mohora nullah.

The present general watertightness of the flume leaves little to be desired; recent observations, most carefully taken, have shown that the total leakage in four miles of practically consecutive channel of this description is but little more than half a cubic foot per second. The flume has been necessarily roofed throughout to exclude soil, etc., from the hillsides above; this includes also the space between the flume and retaining wall at roof level.

The capacity of the flume is well over 500 cu. ft. per second at full depth of flow (8 ft.) and with a velocity slightly in excess of 8 ft. per second. This is equivalent to over 18,000 h.p. at the power house, Mohora.

Deodar (Cedrua Deodara), from Kashmir forests, has alone been used in construction of the flume throughout, and this cedar is reputed to be about the best of its class in the world. About 700,000 cu. ft. of this material have been used on the work.

The total length of wooden flume is 24,666 ft. (4.67 miles); its building was commenced early in 1907, and by the end of the working season, i. e., December, 1907, 18,600 ft. had been finished. The work was resumed at the end of March, 1908, and carried to completion on the 1st of August, 1908.

The silt basin, a most essential adjunct, has been constructed beyond the left bank of the Baniar stream at a point 4,100 ft. from the head works, below which this was the first suitable site available. It is proposed to install a floating sand pumping plant in the near future, with portable engine, to clear the silt from the receptacle at the bottom of the basin, as may be required from time to time.

The Aqueducts.

Of aqueducts there are five major and five minor, over gorges and small watercourses traversed by the supply channel. Of the major aqueducts, the first is a 76 ft. skew span over the Baniar stream, two-thirds of a mile below the head works. Here the girders, which are of "Warren" type, are inverted, the wooden flume being snugly ensconced between the booms, on the lower of which it is thus carried. This affords maximum headway, which was rather limited, for the passage of timber and driftwood, etc., large quantities of which are swept down this stream at times, during prolonged freshet periods. The waterway immediately above this aqueduct, which was rather confined between rock banks, has been considerably improved by the clearance of an obstructive roof of hard rock. The other four major aqueducts are of similar design, but the girders drop from their bearings, and the flume is carried on the upper boom. The clear spans are in each case 80 ft. and the depth between the boom centers 10 ft; the headway from the bed of the gorge below is from 35 ft. to nearly 60 ft. in the case of the last one at Mohora. These aqueducts cross the Chenanwari and Mohora gorges, together with two large intervening nullahs. There are six tunnels on the line, of aggregate length approximately 2000 ft.

Three snowsheds have been constructed over the wooden flume at points where snowdrifts are known to be exceptionally heavy at times. These, it is hoped, will be found effectual in preventing damage to the flume by snow avalanches. These sheds are situated at chains 117, 123 and 205, between Rampur and Chenanwari, and were constructed from rejected planking and timber poles. It was found during the progress of work that during periods of abnormal rainfall very heavy trees and driftwood, etc., as well as bowlders, are likely to be swept down two ravines, situated about half a mile below Rampur, the flow of water in which is ordinarily quite insignificant. The means adopted to forestall anticipated trouble in this respect took the form of very heavy timber floors or aprons, laid over the flume, of which they are quite independent, and supported by substantial crib-work abutments of logs and stones. The timbers forming these aprons are securely dog spiked and bolted, the floors are flanked, with side walls formed of heavy poles bolted to verticals, in stockade fashion. These over-chutes afford ample clearance way for the largest logs or trees that can possibly be brought down, and they have been in existence, together with the snowsheds, for over two years, with most satisfactory results.

The Power Plant in General.

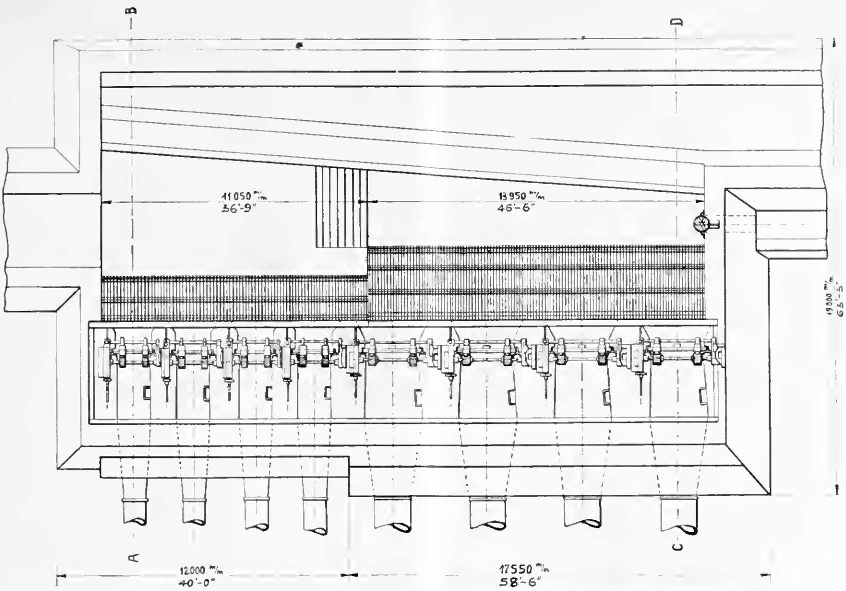
For the design of the power plant proper, consequently also for the arrangement of forebay and pipe lines, three different points of view were of decisive influence.

(1) The fact that the plant was to be located at a point far distant from the origin of the machinery and materials installed, and the impossibility of procuring repair parts without considerable loss of time.

(2) The unfavorable conditions of transportation, as the power plant is accessible only over a mountain road 200 miles long from the railway terminal Rawalpindi, crossing altitudes as high as 7000 ft. above sea level. All material has to be moved by beasts of burden (bullocks); the greatest permissible weight was 4 tons, preferably 2 tons, as the rates for transportation are based on a sliding scale, which goes up rapidly from the 2-ton point. The maximum weights had to be hauled in carts drawn by four animals, two hitched to the front and two to the back of the vehicle.

(3) The power plant was to be installed and operated principally by natives without any experience in this sort of work, and on whose ingenuity, in extraordinary cases, one can count only within moderate limits.

It was decided, therefore, not to go beyond a unit size of 1000 kw. for the first installation of 4000 kw., to make each of the units entirely independent, includ-



Forebay. Jhelum River Power Installation.

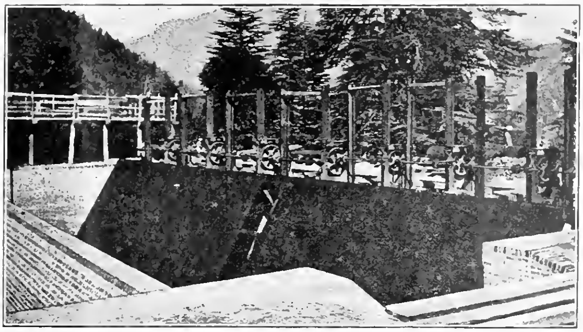


Fig. 6. Forebay, Grating and Operating Mechanism for Main Headgates.

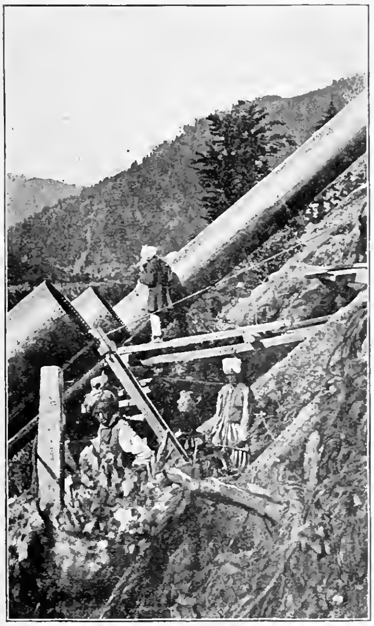
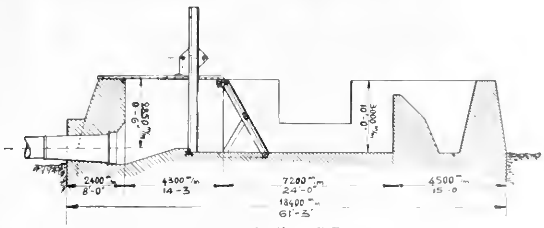
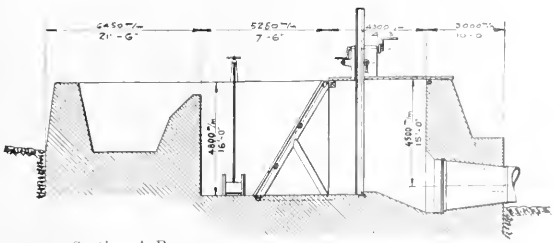


Fig. 7. Installing Pressure Pipe.



Section C-D.



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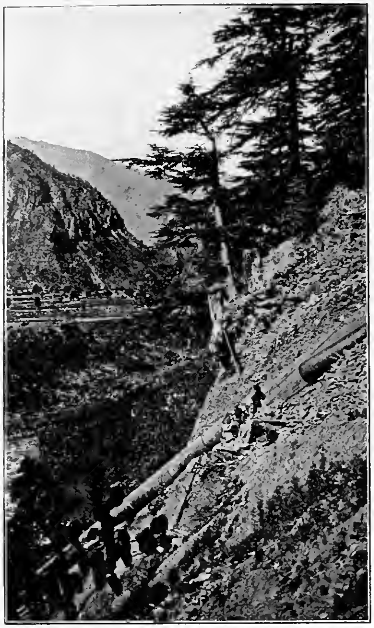
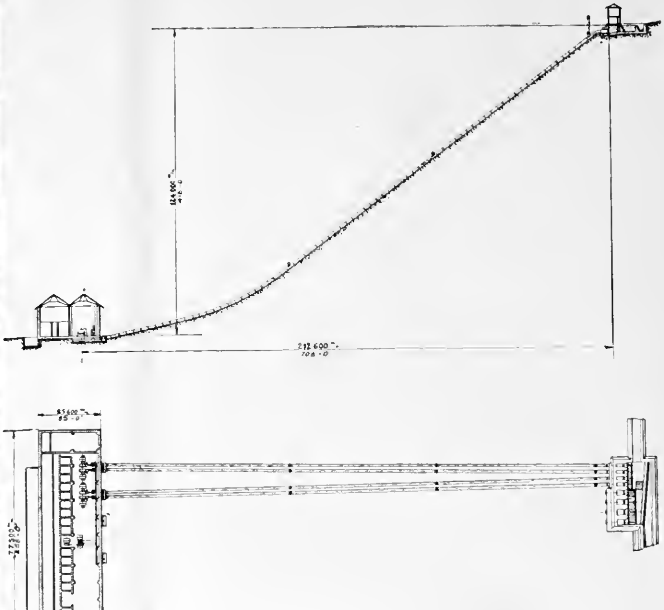


Fig. 8.



JHELUM RIVER POWER INSTALLATION
PIPE LINES

ing a separate pressure pipe, main gate valve near the machine and sluice gate at the forebay. For the proposed extension of the plant, however, pipe lines of larger capacity have been planned, each of which would be sufficient to feed two 1000 kw. units. If the Jhelum Valley Railway should be completed in time for the next following installation of generating apparatus, a larger size of units may also be considered.

The exciter units take their water from a double header pipe, running along the uphill wall of the power house building. This is connected with the main pipe lines by means of special valves. The small motor generator set, to be mentioned later, and the fire service also, connect with this double header.

The Forebay.

The forebay is located on the Mohora plateau immediately overlooking the power station. It has been built, together with the last 1000 ft. of conduit, of brickwork in soorkhee mortar, cement pointed, as stone was not readily available near the site. The extension of the spillway to an existing nullah on the left flank consists of about 500 ft. of wooden flume, and at the foot of the nullah a capacious masonry culvert beneath the Jhelum Road, followed by 300 ft. of similar wooden flume, conveys the surplus water to the spill channel from the power house tailraces, and so back to the river. The forebay has been constructed for the full capacity of 20,000 h.p., and all fittings, gratings, gates with gearings, and inlets for future pipe lines, have been erected complete and in position. The large tapered steel inlets for future extensions have been closed with brickwork which can readily be removed when required. The gates, of which there are eight in all—four of the smaller size for present, and four larger ones for future use—are of deodar wood, made at site; the metal fittings, gearings, etc., for manipulation were imported.

Each gate controls and isolates a separate chamber containing the bell-mouth inlets, which perforate the outer main front wall, giving admittance to the penstock pipes. The bed of the nullah, on left flank of the forebay, being liable to heavy scour, it has been recently decided to spill from the aqueduct over the Mohora nullah, some 1500 ft. higher up the channel, where the bed of this nullah is of very hard rock.

The Pressure Pipes.

Each of the pressure pipes is 750 ft. long, with no horizontal curves, and two bends in the vertical plane are made in the form of welded angle sections. One of the joints near the entrance taper is a slip joint, packed with hemp, in order to permit possible longitudinal movement of the pipe line.

The pipes are made of welded steel, each section is 10 ft. long between the rows of rivets which form the circular joints. The diameters are reduced three times, beginning with 36 in. at the top, and ending with 30 in. at the lower end, the thickness of the plate increasing from 5 mm. to 8 mm. Each course has two longitudinal welding seams, made by the water gas process, and is tapered to the double thickness of the plate, so that every course fits the next following one. The ends of each course were carefully finished and fitted at the works and provided with calking edges; all rivet holes drilled from templates, and every course was tested hydraulically to one and one-half times the static head. The welded seams were tested for tightness by tapping with a short-handled sledge hammer while the pipe was under test pressure. All pipes were coated inside and outside with a rust-preventing compound, and carefully marked before

shipment, so that a mistake in assembling was practically impossible.

For shipment, four sections of different diameters were telescoped into each other and held in place by wooden wedges driven into the spaces between the pipes at each end of the bundle. Finally the ends of the bundles were closed by heavy wooden covers, drawn together by means of three threaded half-inch iron rods with nuts. These were placed close to the inside of the innermost or smallest diameter pipe. Owing to this careful way of packing, which also resulted in a great reduction of space and saving in freight, these light pipes stood the long trip with transshipment at four places, Hamburg, Bombay, Karachi and Rawalpindi, very well, and arrived at the plant in perfect condition.

The laying of the pipe lines began from the bottom; the bottom section of each pipe is provided with a welded flange by means of which it was bolted to a heavy cast-iron fitting of slight curvature. This fitting has a soleplate cast to it and acts as a thrust block, being bolted to a heavy foundation pier. The entire pipe thrust is taken up at that point. To prevent a dangerous vacuum in case of the sudden emptying of a line, automatic air inlets are provided at two points; also a standpipe immediately below the forebay.

The material for the pipe lines arrived in 1907, well towards the end of the season suitable for pipe laying; nevertheless, work was started immediately, and when it had to be stopped in December, all four lines had been finished as far as the Jhelum Valley Road, under which they pass through tunnels, about 156 ft. from the power house. Early in April, 1908, work was resumed, and the installation was finished by the first of August, simultaneously with the completion of the flume.

Where the pipes are exposed they are carried on brick piers, which are 20 ft. apart.

The Power House.

The very heavy excavation in difficult hard bowlder soil, that had necessarily to precede the commencement of the power house, was begun towards the end of 1905 and was completed in June, 1906. The design for the building was adopted after determining present limits as regards length, etc., and adapting details to local requirements. The steel trusses for the roof were procured from Bombay. The building was laid out early in July, 1906, and brought to its main floor level by the end of the working season. It was eventually completed—that is, in the matter of walls, roof, and doors and windows—by end of November, 1907.

The foundations and superstructures to the gallery level, i. e., 20 ft. above the main floor, are of coursed rubble masonry, and the walls above this of mortar class brickwork, all in soorkhee mortar. All concrete and mansonry work in the tailraces and wheel pits, etc., is in Portland cement soorkhee mortar. Concrete was used in all ordinary foundations, etc.

The main floor consists of 6-in. soorkhee concrete, with Portland cement surface rendering; the gallery floors are of Portland cement concrete 7 in. thick, with expanded metal reinforcement; the whole is carried on steel beams, of suitable sections and spacing.

The roof consists of galvanized iron corrugated sheeting, 22 B.W.G., laid upon 1 in. kairoo planking, over common rafters and purlins of similar wood, the whole supported by steel trusses of French type, spaced at 12 ft. 4 in. centers. The roof is double, in two spans, one of 39 ft. 2 in. and one of 40 ft. 2 in., with central valley gutter and down pipes at gable ends.

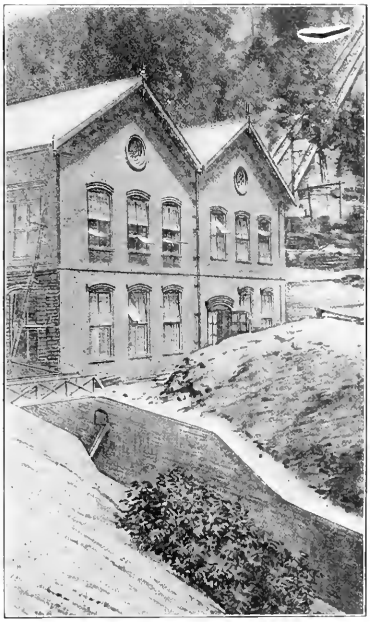
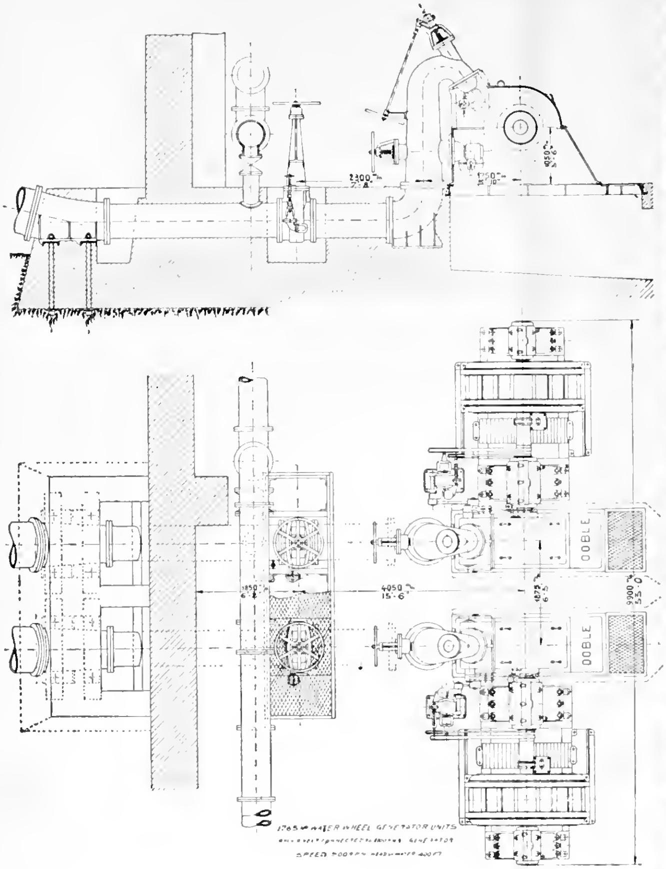
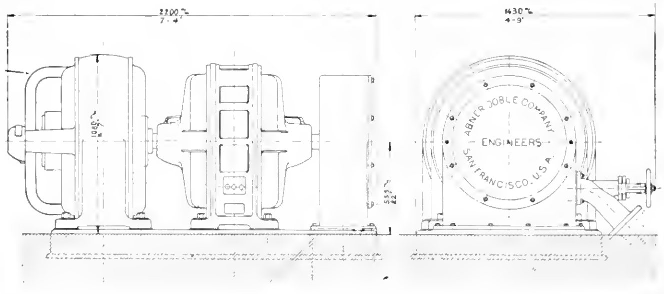


Fig. 10. Power House Building (end view) Tailrace.

The internal dimensions of the building are 183 ft. 6 in. long and 76 ft. wide at main floor level. Two additional tailraces and foundation pits for four more machines of similar size to those now installed, together with six extra transformer compartments, have been provided within the existing building. Should any deviation from the existing type of machines be made in future installations, these foundation pits, etc., can be readily adapted. A spacious machine shop has been provided at the east end of the power house, with an adequate outfit of machine tools and motor-driven shafting, etc. This portion of the building also contains a complete oil-treating plant and a specially constructed pit, to facilitate work upon the main transformers. This generating plant began to arrive late in 1906, by the end of which little more than some line material had been received. Further arrivals accumulated in Rawalpindi during the winter, when the roads to Kashmir are usually closed to heavy traffic by reason of snow. In the spring, however, carting was resumed, and so well maintained that practically the





JHELUM RIVER POWER INSTALLATION

50 HP MOTOR GENERATOR WATER WHEEL SET

SPEED 750 RPM HEAD OF WATER 400 FT

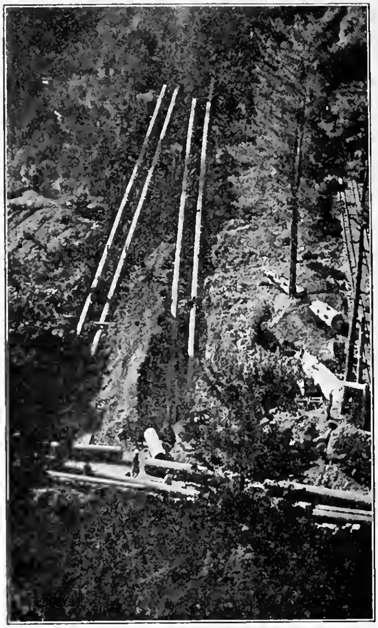


Fig. 9. From Roof of Power House.

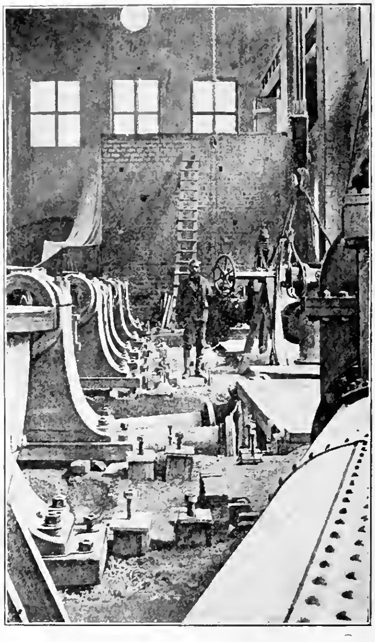


Fig. 11. Power House Interior. Bearings for Main Generating Units. Exciter Header Pipe in Background.

whole of the plant had been delivered by the end of 1907.

A substation at Srinagar has been erected on a suitable central site, within the state silk factory enclosure.

Hydroelectric Machinery.

The machinery so far installed in the power house consists of the following items:

4 main generators, 1000 kw. 2300 volts, 60 cycles, 500 r.p.m.

4 main water-wheels, 1765 h.p., 500 r.p.m.

6 transformers, single-phase, delta-connected for 30,000, 50,000 and 60,000 volts.

2 exciter generators, 150 kw., 125 volts, 500 r.p.m.

2 exciter water-wheels, 275 h.p., 500 r.p.m.

1 motor-generator water-wheel set, 50 h.p., 125 volts, 720 r.p.m.

Water-Wheel Units.

As mentioned before, the main generators are of 1000 kw. rated capacity, and the water-wheels, mounted upon the same shaft as the rotor fields, develop a maximum of 1765 h.p. In order to reduce size, weight and cost of the units, a turning speed of 500 r.p.m. had been selected, although slower speed machines would have given a higher efficiency. This high speed required the application of two jets, plying on one single water-wheel runner.

The main shaft is carried in two bearings of 11 in. and 8 in. diameter respectively, the generator is located between the bearings and the water-wheel runner is mounted on one extended end of the shaft. The generator rotor was pressed upon this shaft after arrival at the plant; the water-wheel runner, cast in one piece, is bolted to a flange, forged upon the end of the shaft, by fitted bolts.

Water is conveyed to the machine from below; the main supply pipe is located below the floor; it has a diameter of 24 in. and is equipped with a main gate valve of the same opening; it is carried up through a 90-degree elbow and terminates in a casting forming a double nozzle in such a way that one jet strikes the wheel horizontally below the shaft and the other one from above it at an angle of 60 degrees from the horizontal. Both nozzles are equipped with regulating needles for hand operation.

The instantaneous regulation is accomplished by cylindrical jet deflectors, and these are operated simultaneously by a vertical Lombard oil governor. This form of regulation in itself does not afford any economy in water consumption, but it was resorted to principally by reason of its simplicity, and, furthermore, cheap labor permits of an ample operating crew in the plant, so that hand operation of the needles and starting and stopping of entire units can be carried to an extreme, which in a plant in this country would rather overtax the operators.

The water-wheel housings are entirely of cast-iron, and, for the purpose of cutting down the weight of the single pieces, and also for facilitating the erection, they are made in four parts. In order to permit a ready inspection of wheels and nozzles, man-holes with bolted-down covers are provided at the side of the housing.

The main bearings have shells with cylindrical support, lined with anti-friction metal. Rack-teeth cast in the outside of the bottom shell make it possible to rack it around the shaft and to remove it without the necessity of lifting the rotor and shaft out of the bearings. All that is necessary is to transfer the weight of these parts upon temporary blocks.

The governors have a pressure and vacuum tank cast with the frame; the oil pump also forms an integral part of the governor, and like, the pendulum, is belted directly to the main shaft.

It is apparent that each unit is homogeneous and independent, from the forebay to the switchboard.

Of the two exciter units (for a third one, foundation pit and pipe connections are provided) either one is sufficient to energize four of the main units. In general design they are identical with the main units, but generator, bearings and base form one element of the unit, and the water-wheel was pressed upon the extended generator shaft after arrival at the plant.

Water is conveyed to the wheel by a single needle nozzle, operated directly by a Lombard hydraulic governor. The latter is mounted upon the nozzle casting and takes its water from the main pipe line.

For the operation of solenoid switches, and to furnish direct current for various other purposes, a motor-generator-water-wheel set was installed in a chamber under the switchboard, consisting of a d.c. generator, an induction motor and a 50 h.p. water-wheel equipped with a needle nozzle for hand operation.

A double line of twenty-one miles length connects the plant with Baramulla, and from there it is continued as a single line to Srinagar (thirty-three miles). The present voltage is 30,000.

The old "jhula" over the Jhelum at Baniar has been replaced by a suspension bridge of permanent type, and a good light bridge of steel wire rope has also been erected just above the power station at Mohora. These have been constructed with materials that had served their purpose on the works, and are primarily intended to facilitate access to the transmission line (the vital importance of which can be hardly overstated) in this, its most difficult section. The bridges at the same time confer on the people of the locality a much-appreciated boon.

The whole of the unskilled, and a large proportion of the skilled, labor throughout has been drawn from Mohora, Srinagar, Poonch and Jammu, so that a number of the subjects of His Highness the Maharaja Sahib have derived substantial benefit in the shape of remunerative employment on these works during three years. Most of the contractors also were residents of Kashmir and Jammu. The whole work, including the erection and installation of plant, both hydraulic and electric, was practically completed on August 15, 1908.

The cost of the entire plant to date has been about $825,000, including transmission lines and distributing system.

The entire electrical equipment was furnished by the General Electric Company, of Schenectady, N. Y., the entire hydraulic equipment by the Abner Doble Company, of San Francisco. The former was shipped from New York via Suez, the latter partly the same way, partly from San Francisco via Hongkong; the pipe lines, from Hamburg via Suez.

Slide rule calculations of pipe discharge can be readily accomplished from the formula $Q = d^2\sqrt{d}\sqrt{h}$ where Q is the discharge in cubic feet per second from a pipe d inches inside diameter laid at a grade of h feet per thousand.

STREET LIGHTING.

BY WYNN MEREDITH.

With the advent of the tungsten lamp the problem of economic and satisfactory street lighting, particularly in residence and suburban districts, has been greatly modified. The low efficiency of the old carbon incandescent lamp made its use expensive and unsatisfactory as compared with arc lamps placed a considerable distance apart. The disadvantage of the arc method of street lighting in resident districts where trees and dense foliage obstruct the direct rays from

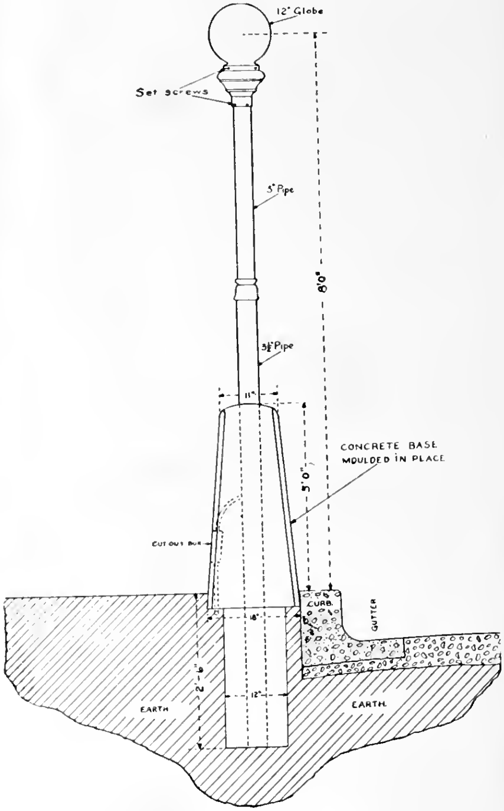
The Alameda Post.

the high hung lamps is apparent, even though arc lamps are placed at each intersecting streets, the middle of the blocks and more particularly the sidewalks are frequently dark and practically without any light at all. The incandescent lamps of the old filament type permitted of a good distribution, but their low efficiency is such as to make the cost of sufficient illumination excessive. The tungsten lamp not only gives a much higher efficiency, but yields a superior quality of light and in both respects closely approaches the arc lamp.

One of the principal difficulties has been the cost of distribution and installation of the ordinary electrolier. This problem has recently been solved in the Alameda, Cal., municipal plant by the construction of a home-made electrolier that has proved in an experimental installation to be quite satisfactory.

On account of the fragility of the tungsten lamp it is of the greatest importance that the lamp support be substantial and rigid to avoid even slight vibrations, which result in an early destruction of the standard voltage tungsten filament.

In the Alameda post, which is not particularly ornamental, massiveness and exquisite rigidity are obtained by means of a cement base, the upper part of the post consisting of ordinary gas pipe with a cast-iron globe holder located 8 ft. above the curb. As a city ordinance requires trees to be trimmed slightly above this height, the light from the post is unobstructed over the entire surface of the street and sidewalks. Posts have been placed about 75 ft. apart on opposite sides of the streets, making the spacing on each side 150 ft. and at the intersection of streets



Details of Construction.

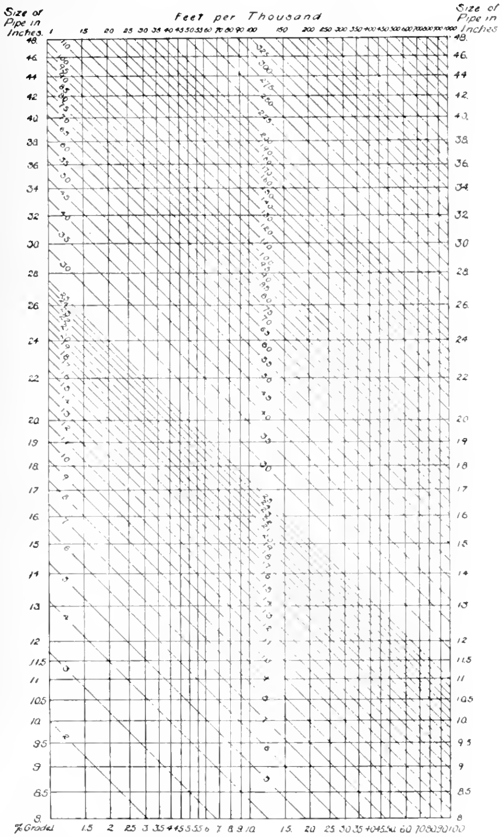
two are placed, one on opposite diagonal corners. The ordinary 110 volt, 60 watt lamp is used connected in parallel and served from a pole transformer connected to a special 2300 volt constant potential street circuit. Each transformer serves the lamps for two blocks each way, the wires being carried down the pole and distribution to the lamps being made under ground with ordinary galva-duct buried a few inches below the sod in the parking between the curb and sidewalk. An outlet box with cover is imbedded in the concrete base, to facilitate the drawing in of wires and to house a double pole fuse block.

Each lamp post costs about $10 erected, and the total cost of the installing including ducts, wiring and painting, is about 20 cents per front foot, or 40 cents per lineal foot of street. This is a remarkably low cost for an electrolier system with underground wiring.

FLOW OF WATER IN PIPES.

BY A. H. HALLORAN.

The accompanying diagram gives a close approximation to the amount of water in cu. ft. per sec. that will be carried by a given sized pipe laid with a given grade, expressed either as ft. per thousand or as per cent. It is calculated for old cast iron pipe but for sizes above 16 in. may be used for riveted steel pipe. The capacity of new pipe is 1.4 greater.



A single example will suffice to show the simplicity of the method. How much water will be carried by an 18 in. pipe a mile long when there is a difference in elevation of 160 ft. between the beginning and end of the pipe? This is practically a 3 per cent grade. The vertical lines show per cent grade, the horizontal lines the pipe size. The oblique line through their intersection gives the flow in cu. ft. per sec. Consequently, following up the 3 per cent vertical line until it intersects the 18 in. horizontal line we find the oblique line showing 15 cu. ft. per minute discharge.

The most economic size of pipe to carry pumped water according to a formula developed in Engineering-Contracting may be determined from the formula $X = 75\sqrt{Q}$ where X is the inside diameter of the pipe in inches and Q is the number of cubic feet of water pumped per second.

EXPERIENCE IN THE SHOP.

BY H. ALTMAYER.

A contractor who had been using a donkey engine to pull a sand drag decided to substitute an electric motor, the high cost of coal being the deciding factor. He accordingly rented and installed a 35 h.p. single phase motor. Unfortunately this would not pull his 2½ yd. scraper 350 ft. a minute, bringing the voltage from 220 down to 180 volts before pulling out of step. As current was transmitted at 2300 volts through five miles of No. 4 wire the electric light company put in a 10 per cent booster and installed 75 kw. transformer capacity, but even then the motor would just haul the empty scraper taking 43 kw. at 205 volts.

As a larger single-phase motor could not be obtained it was decided to couple on another motor by means of two driving pulleys on the jack shaft. There was available a 15 h.p. type C three-phase Westinghouse 1120 r.p.m. motor made when the company was putting in higher grade steel, but still employing the old quantity. This was thoroughly tested with single-phase current, the voltage being raised to 330 and from these tests curves were drawn to show the magnetizing current, iron losses, efficiency and speed. A good point was found on the curve except for rotor losses. After these had been segregated by calculation into bar losses and ring losses it was found by reinforcing the rotor ring that the motor would pull 32.5 brake h.p. at 1165 r.p.m., this being the manufacturers rated full load speed of the single-phase motor and of the three-phase motor reconnected to give the effect of 330 volts when 220 volts were applied.

As the type "C" motor had no starting torque on single-phase it was brought up to speed with the other motor and then thrown on the line. It was found that due to excessive line drop the commutator type of motor had a smaller break down point, and would carry its share of load up to about 30 kw. at 190 volts and the "C" motor would be taking 25 kw., but on heavy load, such as the scraper being caught in the sand, the "C" motor would do more than its share, holding up till the varnish began to run out of the coils and carrying 45 kw. at 185 volts.

An old 10-kw. transformer was stripped of its high tension coils and four sets of 30 volt windings wound on the secondaries, and the commutator type of induction motor was made to carry its part of the load by boosting its voltage to 240 volts, while the other got 210 volts, at which one carried 43 kw. and the "C" 32 kw. on the forward pull at 350 ft. per min. and 25 and 20 kw. for the empty bucket at 500 ft. per minute, it requiring 2.5 minutes for the round trip.

This combination rig was operated successfully for four months, after which they desired to move their hoist 200 ft. As they were doing the moving by power off, the 200 ft. of No. 00 motor line were left on the sand until it could be reset. The next day they telephoned that the motors would not pull their load and it was found that because of extra slack in the line they had coiled each wire separately and hung it on an iron telephone pole step. The consequent choking effect was sufficient to prevent getting good results. After stretching out the lines, the outfit operated until the job was completed.

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Congressional endorsement of the Panama-Pacific Exposition practically assures the success of this undertaking which is destined to bring the Pacific Coast before the eyes of the world in a most favorable manner. Electricity's part in this exposition is to be the most important ever assigned to this convenient form of light and power. The fair means more people to buy more power in every Pacific Coast community.

Our Opportunity

The State, as the sponsor for the corporation, must be adjudged guilty of neglect of its duty in allowing this spoiled child to grow into a head-strong youth. A society for the prevention of cruelty to corporations is no longer needed, for the case now demands the attention of the truant officer. The public service corporation, though not the most recreant of these creations has been the most heedless in estranging its logical friends, the public, whose needs should be served, not exploited.

For discipline and control the State relied upon the time-honored principle of competition, not realizing that telephone, railway, gas and electric service are natural monopolies which cannot be thus restrained. The average consumer is ignorant of the technical processes and specialized knowledge employed in these industries and so has no standard wherewith to compare the value of the service rendered. Consequently it becomes possible for the seller to name his own price and terms. Although all corporations did not take base advantage of this chance, there were enough shortsighted ones to earn for themselves and associates a feeling of public distrust which demands some change in present conditions.

Of the suggested changes the two most noteworthy are governmental operation, as exemplified in municipal ownership of public utilities, and governmental control, as effective in the public service commissions which have been established by a half dozen or more States. The former method not only curbs but also kills the corporation, which is admittedly the most economical form of administration ever devised and which has so many other desirable features as to make its continuance advisable. Furthermore few communities are able to provide equivalent service at equal rates for the same cost to the taxpayer. For a graft-ridden city to operate any public utility is the height of folly.

Rate regulation by local municipal boards has proved a signal failure for over thirty years in California which was the first State to adopt this form of control. National regulation is impracticable in this great country of diversified interests, so the only feasible suggestion is a public service commission. The purpose of such a commission is to protect the rights of the people by establishing fair rates and improved service. Many corporations do not require such an incentive to give satisfaction to their patrons. Those that oppose a public service commission may be temporarily embarrassed by its rulings but, if these are fairly given, will find that the ultimate result will be a financial stability and public confidence of inestimable value.

PERSONALS.

A. M. Hunt returned to San Francisco during the past week after a business trip to Portland.

J. B. Clarkson, of the Western Electric Company's sales department, is making a tour of Central California.

R. E. Danforth, president of the Public Service Railway Company, of East Orange, N. J., is a San Francisco visitor.

F. G. Baum, of F. G. Baum & Co., returned last Tuesday from an engineering investigation in the Sacramento Valley.

H. L. Jackman, manager of the Humboldt Gas & Electric Company, of Eureka, was a San Francisco visitor during the past week.

George I. Kinney, Pacific Coast district manager of the Fort Wayne Electric Works, is making a tour of the Pacific Northwest.

F. B. Gleason, manager of the Western Electric Company's Pacific Coast branch, left last Tuesday on a trip to Salt Lake City.

Frank P. Clark is sales engineer for Chas. C. Moore & Co., engineers at Honolulu where a large number of Hammell oil burners are being installed.

J. M. Ough, who is interested in a hydroelectric project on Kings River, has been confined to an Oakland hospital recently, with a case of appendicitis.

H. H. Noble, president of Northern California Power Company, returned last Wednesday from an inspection tour of the transmission lines in Shasta County.

Thomas Mirk, of Hunt, Mirk & Co., Pacific Coast representatives for the Westinghouse Machine Company, returned to San Francisco from San Diego last Monday.

W. S. Turner has resigned as managing engineer of the Portland, Ore., office of W. S. Barstow & Co., whose several contracts in that vicinity are about completed.

A. W. Whiteford, a steel manufacturer of Bethlehem, Pa., and Knox Taylor, the head of the Taylor Iron & Steel Works, of Highbridge, N. J., were recent San Francisco visitors.

W. B. Foshay has resigned as manager for the Pacific Power & Light Company at Walla Walla, Wash., to accept a similar position with the Washington Oregon Corporation at Vancouver, Wash.

C. E. Thatcher, who recently arrived on the Pacific Coast from the East, has just been appointed City manager of the Western Union Telegraph Company at San Francisco to fill the vacancy created by the resignation of W. A. Newcomb.

Elam Miller has been appointed commercial engineer of the Pacific Telephone and Telegraph Company, reporting to the general commercial superintendent, vice C. F. Mason, who has taken the position of district commercial superintendent of the Los Angeles district.

Louis C. Kelsey, of Salt Lake City, Utah, has opened an office in Portland, Ore., as consulting engineer, and will give special attention to the design and construction of waterworks systems, hydroelectric plants, irrigation, sewers and sewage disposal systems, and pavements.

Louis W. Hill, president of the Great Northern Railroad and interested in the Oregon Electric system extending from Portland up the Willamette Valley passed through San Francisco this week on his way to Los Angeles. He has announced that extensions of the electric railway lines will be made including one from Salem to Eugene, Ore.

F. S. Cromise, manager of the new business department of the Pacific Gas & Electric Company, is in the East.

W. J. Massee, president of the electric power and street railway company at Macon, Ga., is at San Francisco with a party of Eastern capitalists on a tour of the Pacific Coast.

A. H. Hull, who has charge of the General Electric Company's testing laboratory on Bryant Street, San Francisco, recently returned from a Northern California trip.

William A. Newcomb who was appointed San Francisco city manager of the Western Union Telegraph Company about four months ago, resigned during the past week and left for Washington, D. C., to re-enter the service of the State Department in a more important capacity. During his stay in California, Mr. Newcomb won the high esteem of both his fellow officials and his employees besides improving the local service.

A. S. Grenier, heretofore general manager of the Pacific Power & Light Company, has been elected vice-president of that company, in charge of operation and construction. James E Davidson, who has been new business manager of the company, has been appointed general manager. Both officials have headquarters in Portland. H. R. Kingman has been made local manager of the North Yakima branch, vice H. F. Way, who has been appointed assistant to the chief engineer.

Paul Shoup, general manager of the Pacific Electric Railway of Los Angeles, has announced the following department heads effective Feb. 1, 1911. J. McMillan, general manager in charge of the operating department, Geo. E. Pillsbury, chief engineer in charge of construction, E. C. Johnson, assistant chief engineer in charge of maintenance of way; D. W. Pontius, traffic manager in charge of all traffic affairs; S. A. Bishop, general claims agent; George L. Bugbee, land agent of the Pacific Electric Land Company and related companies; W. V. Hill, tax and contract agent; Fred F. Small, mechanical engineer; H. A. Culloden, auditor; S. H. Anderson, electrical engineer; M. S. Wade, cashier; W. G. Sherlock, assistant cashier.

TRADE NOTES.

The Vulcan Electric Heating Company has established offices at 1100 Military Road, Buffalo, New York, also maintaining their office and stock at 542 West Jackson Boulevard, Chicago, Ill. Increased manufacturing facilities have been acquired and the company is now better equipped than ever before to take care of their customers' requirements on Vulcan products.

The Pelton Water Wheel Company recently sent a gang of men to Chile to start the work of a new pipe line for the hydroelectric plant at the Baden Copper Comany's mines. A superintendent of construction will follow them to take charge of the installation of the water wheels.

MEETING NOTICES.

The next meeting of the Portland Section, American Institute of Electrical Engineers, will meet on February 21 in the Electric Building, when E. L. Ritter of the Pacific Telephone & Telegraph Company, will speak on "Telephone and Telegraph Work."

The next meeting of the Los Angeles section of the American Institute of Electrical Engineers will be held at Blanchard Hall, 233 So. Broadway, on Tuesday, February 21st, at 8 p. m. Professor A. W. Nye of the University of Southern California will present a paper on steam turbines. Visiting members are cordially invited to be present.

NEW CATALOGUES.

In Bulletin No. 4809, recently issued by the General Electric Company, is described that company's Type F, Form K-3 oil-break switch.

The Washington, Baltimore & Annapolis 1200-volt, d.c. railway is detailed in Bulletin No. 4808 from the General Electric Company.

Paragon Bulletin No. 2 from the Paragon Sellers Company presents some new facts about grounding with particular reference to the Paragon ground cone.

The January, 1911, number of the J-M Packing Expert, in addition to its usual valuable-suggestions about high pressure steam packings, contains as a new feature an Anti-Trouble Column.

Bulletin 5 C from the national engineering department of the National Electric Lamp Association is devoted to tantalum multiple lamps, 100-125 volts and 200-250 volts, 25, 40, 50 and 80 watts.

Electric Sign Lighting is the subject of Bulletin 15 from the engineering department of the National Electric Lamp Association, giving data on performance, economy equipment and applications of "Mazda" and carbon sign lamps.

Bulletin 8 B from the engineering department of the National Electric Lamp Association illustrates and describes "Mazda" miniature and low voltage lamps for automobile, signs and other battery uses for voltages from 1.5 to 20.

Straight air-brake equipments are illustrated and described in Bulletin No. 4798, recently issued by the General Electric Company. This bulletin should prove of interest as well as of service to all connected with street railway work.

Catalogue No. 463 from the Sprague Electric Company contains a complete list of Sprague conduit products conveniently arranged for quick use. These include iron-armored insulating conduit and fittings, knockout and outlet boxes and covers, and flexible steel-armored conductors and fittings.

Catalogue H from the National Tube Company is a 470-page volume comprising material manufactured at their Kewanee works and embracing wrought pipe for steam, gas water and ai., cast, malleable iron and brass fittings, valves and cocks, radiators and coils, and drive well points and well supplies.

The General Electric Company has just issued Bulletin No. 4685, which is a revision of a previous bulletin on belt-driven alternators. The alternators illustrated and described in this publication are of the revolving field type and range in capacity from 30 to 550 kw. The bulletin contains dimension diagrams of the complete line.

Bulletin No. 4785, recently issued by the General Electric Company, is devoted to the subject of electric drive in woodworking plants and advantages to be derived from the use of electric motors in this industry. The bulletin illustrates and describes the electric motor as a part of wood-boring machines, drills, jig saws, rip saws, band, circular and swing saws, planers, etc.

A publication which should prove of interest to those connected with the manufacture of paper is Bulletin No. 4784, just issued by the General Electric Company, and devoted to electric drive in pulp and paper mills. The advantages to be derived from the use of electric power in this industry are set forth in the bulletin, and descriptions of a number of important installations are also included.

The Western Electric Company has just issued Bulletin No. 1006, describing non-multiple toll switchboards. The boards described are divided into two general types, those having self-restored line signals and those with manually-restored line signals. Considerable space is devoted to the combined jack and signals used with the first type of boards. The bulletin, which contains thirty-six pages, is illustrated with many photographs and diagrams and contains a table showing the capacity of standard types of non-multiple toll switchboards.

Steady vs. unsteady voltage is the title of Bulletin No. 4793 from the General Electric Company. This publication illustrates and describes regulators for controlling the generator voltage and also those for regulating the feeder voltage. There are reproductions of curves showing voltage with and without regulators installed. The bulletin illustrates installations of both types of regulators.

Bulletin No. 4804, recently issued by the General Electric Company, is a revision of the company's previous bulletin on direct connected generating sets. These sets, while originally designed to meet severe conditions of marine work, are also well adapted, and have been used extensively for both power and lighting in isolated plants, and as exciters for alternating current generators in central station work.

The General Electric Company has developed a line of air compressors having piston displacements of from 15 to 100 cubic feet per minute. These compressors are portable and were designed for use where the installation of a system of piping is not feasible. These sets are mounted upon three-wheel trucks which can easily be moved from one place to another. A detailed description of these sets is given in Bulletin No. 4810.

Air compressors are illustrated and described in Catalogue No. 549 from the Platt Iron Works Company, Dayton, O., particularizing on Smith-Vaile air compressors, both steam and power driven in single and duplex simple and two-stage types. Catalogue No. 555 from the same company is devoted to Smith-Vaile general service pumps both steam and power driven. Chas. C. Moore & Co., engineers, are general Pacific Coast representatives.

Bulletin No. 4807, recently issued by the General Electric Company, illustrated and described panels designed for use in small or isolated plants containing but one generator. The bulletin describes panels of two sizes, 76 and 90 inches, the only difference in the two sizes is that the larger panel contains the necessary apparatus for controlling a constant current transformer. The publication contains dimension and connection diagrams.

Bulletin No. 9465, describing the Moore light for color matching, has just been issued by the Western Electric Company. This is declared to be the only artificial illuminant which gives exact daylight color values, and it is being introduced into shops, mills and other establishments where color values are of great importance. The white Moore light is a radical new form of the electric light. It is a vacuum tube electric light produced by the passing of alternating currents through highly rarified carbon dioxide gas confined within a continuous clear glass tube. The bulletin contains a description of this illuminant and of its uses and operation. A page is devoted to the list of concerns now using this, and another to tabulated dimensions, data, etc.

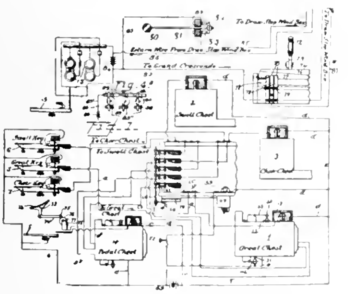
In a new 48-page catalogue recently issued by the Lagonda Manufacturing Company of Springfield, Ohio, (Chas. C. Moore & Co., Engineers, Pacific Coast agents), is discussed the relative advantages and different conditions under which it is most suitable to use the various types of boiler tube cleaners. Besides boiler tube cleaners, other boiler room devices are briefly described, such as the Lagonda water strainer for removing impurities from boiler feed or condenser water, the automatic feeding device for removing scale from Stirling boilers without entering the drum, the Lagonda double action cut-off valve for automatically shutting off steam in case of break in the line, besides other devices such as tube cutters, reseating machines, etc.

PATENTS

982,380. **Electric-Pole Stand.** David A. Martin, Republic, Wash. In a support for poles or the like, the combination with a flexible, metallic tubular casing adapted to be permanently set in the earth and serve as a stand and to directly receive the pole and provided with a split upper part adapted to

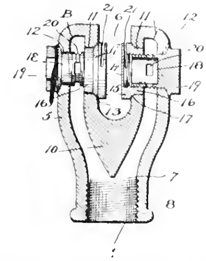
directly engage the pole, of a clamp independent of and slidable on said split upper part of the support and adapted to be located at any desired position to cause said split upper part to clamp the pole to the casing subject to release and removal of said pole without disturbing the casing.

982,419. **Electrically-Operated Organ.** William B. Fleming, Los Angeles, Cal. In an organ the combination of a great wind box; a wind channel having an exhaust, said channel being communicable with said wind box; a pneumatic; valves actuated by said pneumatic to control the communication of said wind box with said channel and the exhaust therefrom; a wind channel communicable with said pneumatic and with



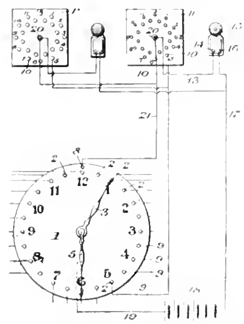
the great wind box, said channel having an exhaust; a second pneumatic; valves actuated thereby to control the communication between the wind box and the channel leading to the first pneumatic and the exhaust from said channel; a channel leading from said second pneumatic to the open air; an electro-magnet to control said last channel; means to operate said electro-magnet.

982,424. **Liquid-Fuel-Burner Tip.** William F. Goodwin and Joseph C. Low, San Francisco, Cal. A burner tip comprising a fluid conveying element including spaced walls, said walls having openings therein, a nozzle member engaged in one of the openings, and a nozzle fastening member engaged through the other opening and connected with the nozzle member, said nozzle fastening member being hollow, and



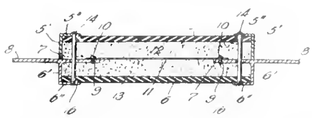
having passages communicating with the interior of the nozzle member, and with the interior of the conveying member, for the passage of fluid from the conveying member through the nozzle member.

982,495. **Electric Time-Alarm for Hotels, etc.** George M. Hinman, Lindsay, Cal. An alarm system consisting of a main circuit closing clock provided with contacts, dials with contacts corresponding to those on the clock, connections between the two sets of contacts, batteries and alarm devices in



the circuit of said connections, an auxiliary contact on each dial, a detachable plug normally engaging said auxiliary contact to connect the same in circuit, an auxiliary contact on said clock, and means to form a connection between said clock auxiliary contact and the other clock contacts to close a plurality of alarm circuits.

982,738. **Inclosed Fuse.** Charles R. Moellendorf, Seattle, Wash. An electric fuse comprising complementary shell parts of insulating material complementary cap elements of conducting material mounted upon the ends of the respective shell parts, a fusible element, tongues extending inwardly and



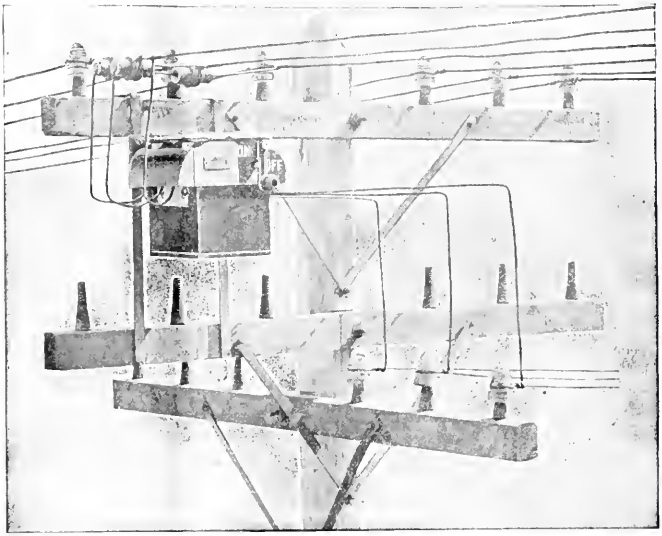
outwardly from the cap elements of one of said shell parts, means for detachably connecting said fusible element to the inwardly-extending tongues, and means extending through the inwardly-extending tongues and the shell parts and their caps for detachably securing the said elements together.

INDUSTRIAL

TYPE F, FORM P, OIL BREAK POLE LINE SWITCH.

BY D. S. MORGAN.

Owing to the magnitude and complexity of the electrical distribution systems of the present day, it is important in many cases that means be provided for cutting portions of the circuit in or out of service by suitable devices installed at points which necessarily must be remote from the station. Such a device must be designed for installation out of doors and for operation under load, and would find application in sectionalizing feeder systems, cutting in and out transformers and in similar service. In many cases, the use of this switch in connection with a transformer will obviate the necessity of bringing high tension lines into the building. To meet this demand the General Electric Company have designed an oil break switch which is simple, introduces no complications in wiring, and, on account of the convenient construction of the frame and method of supporting, is easily installed. It can be mounted on a flat surface or, by use of strap iron hooks, on transmission pole cross arms in a manner similar to that usually employed for mounting pole type transformers.



General Electric Non-Automatic Oil Break Switch Designed for Pole Line Service.

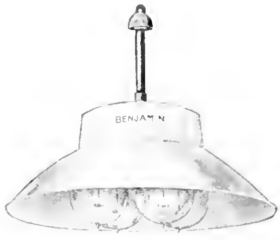
This pole line oil break is thoroughly weatherproof. It is entirely enclosed in a cast iron frame, fitted with a removable cover, grooved on the under side to fit closely to the edge of the frame and supplied with a suitable gasket which prevents damage to the mechanism due to weather conditions. A detachable oil vessel, with insulating line and barriers between the switch poles, fits around a flange at the bottom of the frame. The stationary contacts are flared fingers of drop forged copper, supported from the contact blocks of the copper current carrying studs, by a heavy flat steel frame. The studs are supported by and insulated from the frame by porcelain insulators. The movable contacts are wedge shaped copper blades hinged at one end. They are actuated by specially treated wooden rods connected to the shaft which in turn is operated by the crank and handle outside of the frame. The construction of the stationary and movable contacts is such that any burning, due to rupturing the arc, is confined to the tips of the stationary contact fingers and the upper extremity of the movable contacts, preserving the actual current carrying surfaces. This feature of construction insures clean contact surface and uniform contact pressure without retarding the opening of the switch.

This switch is built in sizes up to 200 amperes at 15,000 volts. The method of bringing the leads to the switch varies somewhat according to the voltage, but in every case they enter through porcelain bushings protected from the weather by the overhang of the frame. The switches up to 4500 volts are designed for use with insulated wire, while for voltages between 4500 and 15,000 bushings are furnished which allow the use of bare wire.

BENJAMIN MILL CLUSTER.

In line with the activity for improved conditions in the matter of industrial lighting, the Benjamin Electric Manufacturing Company of Chicago, have placed upon the market a cluster fixture which is intended to replace arc lamps in mills, factories, foundries, etc.

The illustration shows Cat. No. 0664½ with 24 in. enameled steel concentrating dome reflector for meeting requirements where it is necessary to hang the light units sufficiently high to clear traveling cranes. A second form, their Cat. No. 0684½, has a 24 in. enameled steel flat cone



Benjamin Mill Cluster.

distributing reflector, and is designed to be suspended from twenty-five to thirty feet above the floor. Both fixtures have sockets for 250-watt (S-40-B) large base lamps. They are furnished wired in series for 220 volt circuits or series-multiple for 110 volt circuits. A reflected light volume of approximately 1500 c.p. is secured.

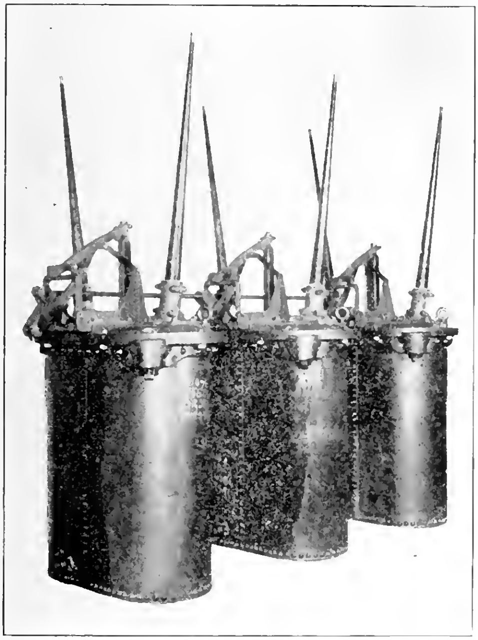
The manufacturers have a Mill Cluster Bulletin giving curves showing the light distribution, together with tables furnishing data on single cluster unit illumination, or the cumulative illumination of a plurality of single units, in foot candles. Copies may be secured on application.

A catechism on direct current apparatus has been issued by Fairbanks, Morse & Co., Chicago, giving, in simple language, definitions for electrical terms and describing the construction and uses of different electrical machines.

HIGH TENSION CONDENSER TYPE TERMINALS.

A new type of terminal for high tension apparatus has recently been developed by the Westinghouse Electric & Manufacturing Company utilizing a principle not used for this purpose before.

The terminal is constructed of alternate concentric insulating and conducting layers, forming a series of condensers which serve to make the distribution of potential stresses in the insulating material uniform and thus increase dielectric strength of the terminal. As a result a much smaller terminal can be used for a given voltage with a corresponding saving in cost of the entire piece of apparatus and a gain in dependability under conditions of abnormal stresses due to surges, lightning and similar causes.



Oil Circuit Breaker Equipped With High Tension Condenser Type Terminals.

It can be readily seen that any terminal passing through a metal tank forms in effect a curved condenser, the plates of which are the surface of the terminal and the surface of the hole or bushing in the tank. The insulation between the two is the dielectric of a condenser and is subject to all the conditions affecting such a dielectric. It can be shown both mathematically and experimentally that the static stresses in the dielectric of a curved condenser are not uniform throughout the thickness, but are greatest near the inner surface. Therefore the thickness of the insulation must be made such that the inner layers will not be subjected to dangerous stresses, which result in the outer layers being thicker than necessary. Looking at the matter in another way, if the insulation is designed for a certain voltage per inch of thickness, there will be danger of breakdown due to the higher stresses near the inner surface. For low voltages the unnecessary thickness of insulation, is not important, but for voltages of 70,000 and over the ordinary insulator becomes so large as to necessitate an increase in size of the entire apparatus.

By interposing the metal layers, the difference in diameters of the plates of each condenser is reduced and the distribution of the potential made more uniform, which results in a saving of unnecessary thickness of insulation. An idea of the saving effected can be had by a comparison of two terminals designed and tested for 200,000 volts. An ordinary bulk type terminal for this voltage is about 9 ft. in length and 16 in. in diameter including insulation. A condenser type terminal for the same voltage is 7 ft. in length and 4 in. in diameter, the volume of the former being 8 times the latter.

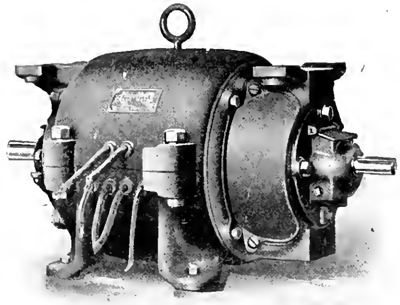
The condenser type terminal is constructed by winding the successive layers on a central outlet tube. The insulating layers consist of a special grade of paper wound under pressure and cemented and pressed together into a solid mass without weak spots. On each thickness of insulation is wound a layer of metal foil. The layers are so finished that each is shorter than the one beneath it, thus tapering the terminal and providing a creeping surface between successive conducting layers. The creeping surfaces on the end projecting into the air are, naturally, larger than those at the end submerged in oil. A heavy metallic flange is fastened to the outside of the terminal to serve as a support for mounting it in the tank.

The illustration shows a 60,000-volt oil circuit-breaker equipped with condenser type terminals. The Westinghouse Electric & Manufacturing Company supply these terminals with all high voltage transformers, circuit-breakers, electrostatic voltmeters and similar apparatus.

A NEW CRANE MOTOR.

A new direct current, reversible and totally enclosed crane motor, known as the "Western Electric" Hawthorn type HLA, has just been placed on the market. This motor combines high electrical efficiency with a compact and rigid construction, which insures absolute reliability under the severe conditions common to crane and hoisting service.

These motors are of the totally enclosed, split frame type, and are built in sizes ranging from 1¾ h.p. at 1375 r.p.m. to 50 h.p. at 525 r.p.m. The frame is cylindrical in form and of small diameter, requiring minimum head room and reducing the moment of inertia of the revolving parts. The frame is cast of soft steel and designed with a low center of gravity and ample feet surface for rigidly bolting in place. The upper half of the frame may be lifted after removing six or eight bolts, depending upon the size of the motor. This leaves the armature and bearings intact. The heads are not split, but can be lifted out after removing the upper half of the frame and the bolts which secure the heads to the lower frame. This leaves the motor practically disassembled.



Western Electric Type "H L A" Crane Motor.

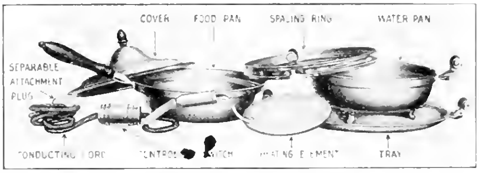
The motor heads which are held in place by four bolts are provided with brackets for the mounting of the back gear shafts and brake pads for the addition of magnetic

brakes. These motor heads are adjustable, which permits of the motor being mounted in various horizontal positions.

The laminated pole faces which are cast with the frame are securely bolted to the poles. This eliminates iron losses and insures cool operation. The bearings are of the self-oiling, revolving ring type and their surface is provided with bronze linings. This arrangement insures the efficient lubrication and good wearing qualities necessary for heavy duty. The armature core and commutator are mounted on a quill to facilitate easy removal from the shaft without disturbing the windings. The commutator, coils and brush holders are of the latest improved design and are made for heavy duty.

A CHAFING DISH WITH AN IMMERSION TYPE HEATER.

It is well established that the efficiencies of resistor materials for heating devices cannot be improved. The best energy developed by the passage of an electrical current through a resistance will always equal I^2R. Obviously, several resistors of different materials, all having the same resistance, through which a current of a certain value flows will each develop precisely the same amount of heat. Improvements in the efficiencies of electric heating devices must, then, come through the effective utilization of the heat that is produced by the flow of electric current through heating elements. The efficiencies of the elements themselves cannot be improved. Every reasonable precaution should, in the efficient heating device, be taken to prevent the loss of the electrically generated heat.



Exploded View of Chafing Dish.

The principles of heat conservation advocated in the above paragraph are embodied in the construction of the new Westinghouse electrically heated chafing dish which is illustrated herewith. This device consists of an ordinary chafing dish to which is added a Westinghouse disc-type heater and a spacing ring to provide for its admission.

The heater is of the disc-immersion type and is immersed in and is wholly surrounded by the water in the water pan. Evidently, all of the heat developed must be imparted to the water. There can be no losses of heat through direct radiation from the heater. The water pan is nickled and highly polished which retains losses from radiation from the hot water at a minimum.

The Westinghouse disc-type heater resembles somewhat a stove lid with its handle permanently attached. The conductors to the heating element are carried up through the "handle" which is called the lead arm. A specially prepared cord, a telescopic 3-heat control switch and a separable attachment plug are permanently attached to each heater. The resistors (heating elements) in Westinghouse disc-type heaters are hermetically welded between the sheet copper plates which form the two surfaces of the disc. The resistors are in intimate contact with, although thoroughly insulated from these two plates. This construction effectively prevents oxidization and insures that the temperature of the heating element will never rise more than a few degrees above that of the outside of the heater and of the liquid in which the heater is immersed. The Westinghouse disc-type heater is not in any way fastened in the water pan and can be readily removed for cleaning at any time. The heater can be used for heating liquids is any vessels that will contain it. Any alcohol heated chafing dish of the usual size can be equipped for electrical operation by the addition of a heater and spacing ring which is slotted to provide for the admission of the lead arm to the heater. Both of these parts are sold separately or in combination with a chafing dish by the Westinghouse Company.

Disregarding the matter of thermal efficiency, the following advantages are claimed for the Westinghouse chafing dish:

1. All parts are readily accessible for cleaning.

2. The heater can be used for heating liquids in any vessel that will contain it.

3. If through oversight the water is allowed to boil entirely away the heater will operate in air, at normal voltage, for an indefinite period without harm.

4. There are no porcelain or moulded asbestos parts which are brittle employed in the apparatus. No brittle or fragile materials are used.

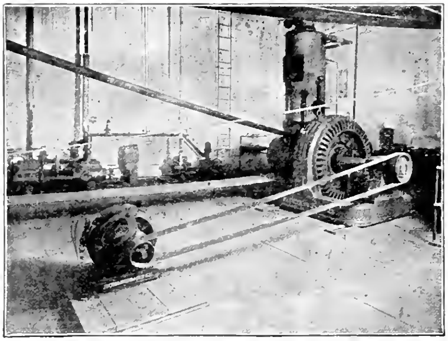
5. The heater and spacing ring will fit any alcohol heated standard chafing dish of 3 pints capacity. Having an outside diameter of water pan rim of from 8¾ to 9⅜ in.

The three heats take 125, 250 and 500 watts respectively.

ELECTRIC PLANT OF KINGFALFA MILLS, NEBRASKA CITY, NEB.

The extensive use of alfalfa meal for stock feeding in our western states has caused a very rapid growth of a new industry; namely, the grinding of alfalfa stalks for the production of this highly nutritious product. The mills are usually electrically driven and they form an attractive example of the way in which electric power contributes to the development of a new industry.

A typical installation is that of the Kingfalfa Mills at Nebraska City, Neb. Their plant consists of a 300 k.v.a., 440-volt, 600 r.p.m., 3-phase, 60 cycle, alternating current generator of the two-bearing, belt-driven type; this is driven by a 300 h.p., simple, non-condensing Corliss engine, and the power developed is used to drive a disintegrator or alfalfa meal mill and other auxiliary machines, such as blower, dust collector, packer, etc. The alfalfa mill is driven by a 150 h.p. slip-ring type motor, which is belted direct to the mill.


Electric Plant of Kingfalfa Mills.

On account of the great weight of the mill and the inertia of the moving parts a high starting torque is required to start and bring it up to speed, which is a severe test on the capacity of both the motor and generating plant.

The capacity is four tons per hour of the finished product, and in a test of several hours continuous operation has been worked to the capacity of six or seven tons per hour. The entire electrical equipment was manufactured and installed by Fairbranks, Morse & Co., through their branch office at Omaha, Neb.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Sierra-Blue Lakes Water & Power Company has been incorporated by Eugene J. Sullivan, Walter E. Sullivan and Geo. H. Richardson, with a capital stock of $75,000.

SAN FRANCISCO, CAL.—The La Sierra Heights Water Company has been incorporated by J. E. Coberly, Edwin Higgins, A. B. A. Briggs, H. G. Hubbard, and J. O. Smith, with a capital stock of $1,000,000.

REDWOOD CITY, CAL.—The Sierra and San Francisco Power Company has filed amended articles of incorporation. The principal place of business has been changed to Millbrae. The capital stock of the company is $20,000,000 and the directors are: J. S. Thornton, Winfield Dorn, H. F. Jackson, Geo. H. Whipple and W. Gregory.

SAN FRANCISCO, CAL.—Articles of incorporation of the California Power & Manufacturing Company, capitalized at $5,000,000, have been filed by F. G. Baum, Charles W. Slack, Chauncey S. Goodrich, George H. Ray and John T. Pigott. The company proposes to own and operate water plants for power, lighting, irrigation, electricity and heating in Northern California.

TRANSMISSION.

CHELAN FALLS, WASH.—Power stations will be established at Entiat and Chelan Falls in the spring by George D. Brown of this place.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has applied to the county for a franchise for 30 miles of pole line to supply power and light for its telephone properties.

EUGENE, ORE.—The Oregon Power Company is asking proposals for materials to be used in construction of the power plant at Martin Rapids on the McKenzie river. Manager Spencer is now on his way to Chicago to confer with officials as to other work.

BISHOP, CAL.—F. B. Mechling, commercial agent for the Nevada-California Power Company, from Goldfield, has made a trip through southern Inyo and lower Owens Valley and signed up business for the company prospective toward the extension of the power lines down the valley.

OROVILLE, CAL.—According to H. H. Sinclair, general manager of the Great Western Power Company, the only work that will be done this year will be the addition of another unit to the power plant at Big Bend. This work will cost in the neighborhood of $200,000.

SPOKANE, WASH.—According to D. L. Huntington, president of the Washington Water Power Company a new power house will be built on the Spokane River this side of the recently completed Little Falls unit, and there is a transmission line to be built from the plant to Spokane.

PLACERVILLE, CAL.—Engineers have prepared a camp at Chili Bar on the south fork of the American River for the complete survey and platting of the power-site ditch right and other interests at Chili Bar owned by John Pearson of this city, and now under bond to the Sacramento and Sierra Railway Co. The engineers are under Civil Engineer J. A. Graham of Berkeley. A few weeks ago John P. Fisher, former county clerk of El Dorado County and now a trusted agent of the Sacramento and Sierra Railway Company appropriated 5000 miner's inches of the water of the south fork of the American River and it is now apparent that the appropriation of water will be used for the purpose of the development of electricity. That the Sacramento and Sierra Railway Company is considering the enterprise of constructing a great power plant for the generation of power to operate its cars is evident.

FINANCIAL.

NEWPORT BEACH, CAL.—The City Trustees last week offered a resolution of intention to call an election to vote for the purchase of a gas and electric light system for Newport. The electric light company places a valuation of $15,000 on its plant. The Board decided to make a bond issue of $55,000, interest 5 per cent, and to pay off two $1000 bonds each year after five years had elapsed. It will not take the amount named to purchase the plants but the Board wants to have bonds voted and then sell them as they are needed.

PORTLAND, ORE.—The American Power & Light Company, of 71 Broadway, New York, have purchased the Hood River Light & Power Company, of Hood River, Oregon, a company owning a generating plant on Hood River, and supplying the town of Hood River with power, light and water. The following new officers have been elected for the Hood River Company, and hereafter it will be operated by the same management as the Pacific Power & Light Company: President, Guy W. Talbot, vice-president, A. S. Grenier; secretary and treasurer, Geo. F. Nevins; assistant secretary and treasurer, Lewis A. McArthur; general manager, James E. Davidson. The new officers of the Hood River Company will be in the Spalding Building, Portland, Oregon. The American Power & Light Company already controls the following companies in Oregon and Washington: Pacific Power & Light Company, Portland Gas & Coke Company, Walla Walla Valley Railway Company and Hanford Irrigation & Power Company, all of which have headquarters in Portland. It is understood from press reports that a 66,000-volt line will be built by the Pacific Power & Light Company from its present plant at The Dalles, westward along the Columbia River 22 miles to Hood River, in order that the Hood River Light & Power Company may have additional power service to fall back on in case of emergencies. It is also reported that additional development will be made at Hood River, and that more distribution lines will be built in the Hood River Valley.

TRANSPORTATION.

MARSHFIELD, ORE.—It is announced that the Lane County Asset Company has financed 20 miles of electric road from Eugene to Florence.

BELLINGHAM, WASH.—The Chamber of Commerce has recommended that the city subscribe sufficient funds for the construction of the first nine miles of the Nooksack Valley Traction & Railway Company.

MISSOULA, MONT.—Local business men are considering the construction of a Missoula-Kalispell electric railway line across the Flathead country and of an electric road through the Frenchtown and Grass Valley countries.

SAN BERNARDINO, CAL.—Preparatory to linking this city with Los Angeles via Riverside, the San Bernardino Traction Company has commenced to tear out its roadbed along Third street, replacing the track with 100 pound rails. The entire system throughout the valley will be replaced with heavier rails.

PORTLAND, ORE.—Application for a subway franchise has been made by the chief engineer of the Baker Interurban Railway. It provides for a complete street car system in addition to the bore under the Willamette river.

PORTLAND, ORE.—John F. Stevens, president of the North Bank Railroad, announced that only two electric roads will be built in Oregon this year, one is the Eugene extension 75 miles long, extending to the coast. Contracts for construction will be let at once. The other road is the Tillamook line.

SACRAMENTO, CAL.—The people of the city who live in the vicinity of C street, between Nineteenth and Twenty-seventh streets, have sent a petition to Mayor M. R. Beard requesting him to urge the Northern Electric Railway Company to extend its local service line up C street, from Eighteenth to Twenty-fifth.

SACRAMENTO, CAL.—Plans and specifications have been drawn for the remodeling of the Northern Electric Company's building at Eighth and J streets, the work to begin in early spring. The present walls of the structure will be torn down and a pressed brick and plate glass effect substituted. New tile flooring will be laid throughout the building and the heating arrangements and electric apparatus will be modern.

MEDFORD, ORE.—John R. Allen, who has held a franchise for a street railway, started work on it just 48 hours before the franchise expired. Two blocks of track on the main street were laid. No engineering work has been done, and no stakes set. A. Welch, 502 Fenton building, Portland, owns the Allen franchise. He has sent Jas. R. Thompson, an engineer, to Medford to start on this system, which will ultimately cover the entire Rogue river valley.

OAKLAND, CAL.—The statement of Vice-President E. E Calvin of the S. P. Co. that the proposed ordinance, passed to print two weeks ago, granting the railroad a franchise on Seventh street, was not approved by its president, has defeated the possibility of the awarding of the grant on the Oakland plan, as outlined by Chairman Ben H. Pendleton of the City Council. The matter will have to be entirely reconsidered, and will come up at the next meeting of the Council.

PETALUMA, CAL.—The Petaluma & Santa Rosa Electric Railway Company, through its president, E. M. Van Frank, has asked the Petaluma trustees to grant a franchise to the company for a line through this city. A. W. Bullard, the San Francisco representative of Rollins & Sons, financed the project to extend the local electric line to deep water. The terminus will be at Point Pedro, where it is proposed to have fast steamers meet the road and convey the passengers and freight to San Francisco.

STOCKTON, CAL.—After a long drawn out controversy the city trustees of Modesto have voted to advertise for sale the franchise asked for by the San Joaquin Valley Electric Railway. This means that the Brackett electric road, which is now pushing construction work on its line between Stockton and Modesto, will gain the desired entrance to the Stanislaus county seat. The franchise will be on Elm street, from the city limits to Eighth, on Eighth to F, with a spur for passenger purposes only from Eighth to Ninth on I street. At a meeting held the directors of the San Joaquin Valley Electric Railway was increased by the addition of Fred W. Rothenbush, the Stockton brewery man, and Andrew McCormick, the cattleman and meat dealer.

PORTLAND, ORE.—Ten acres of land have been purchased by the Portland Railway, Light & Power Company in southeast Portland upon which will be built the company's new car shops. The tract lies directly west of the large shops of the S. P. Co. The 11-acre tract at Powell and Twenty-sixth streets, bought recently by the company, will be used for a material yard with the intention of erecting car barns upon a portion of the land as the demand for shelter for the company's rolling stock increases. Vice-president F. I. Fuller is now having the plans for the new shops drawn up and that construction will be commenced as soon as possible. The shops will be built in units, the first unit to cost about $300,000. It will be a fireproof structure of brick or concrete. Other units will be added in accordance with the demand. One very important factor in industrial Portland will be the manufacture of cars instead of sending to Eastern or Middle States factories for them. Last year the company bought 120 new cars.

OAKLAND, CAL.—The plans of the United Properties Company to extend the Oakland Traction and Key Route systems to Sacramento and San Jose were revealed last week, when the incorporation papers of the Sacramento Short Line and San Jose Short Line Railways were filed. According to the plans of the corporation the Key Route system known as the San Francisco, San Jose and Oakland Railway, will be extended 98 miles into Sacramento, there to connect with the Northern Electric Company. The San Jose extension will be but a continuation of the Oakland Traction Company, whose lines at present terminate in Hayward. A franchise and rights of way have already been secured for the extension of this line into San Jose. The Sacramento Short Line is capitalized at $10,000,000 and the directors are attaches of the office of Gavin McNab, one of the incorporators of the United Properties Company. Of the capital stock, B. M. Aikens, McNab's chief aid, has subscribed $84,000, and the remaining directors, R. P. Henshall, Luther Elkins, George W. Mordecai, N. Schumlowitz, R. V. Whitney and F. L. S. Stewart, have subscribed $1000 each. The same directorate appears in the incorporation papers of the San Jose Short Line. The capital stock is fixed at $80,000.

ILLUMINATION.

ARLINGTON, ORE.—C. H. Busey has petitioned the Council to erect and operate an electric lighting plant in this city. The matter has been taken under advisement.

LONG BEACH, CAL.—The Towne Electric Company of this city will install electric power fixtures and lighting for the new Polytechnic and Academic high school. The company's bid is $5950.50.

TUSTIN, CAL.—Residents of Tustin have presented a petition to the Supervisors asking for the formation of a Pacific Highway Lighting District and a resolution has been adopted by the Board calling an election for February 6th to vote on the proposition of forming a district to be known as the Tustin lighting district of Orange County.

MERCED, CAL.—Mr. J. M. Berkley, consulting engineer of the San Joaquin Light & Power Company, visited here last week in connection with the plans which the company is making for the improvement of the gas system at Merced. This improvement will embrace the entire reconstruction and rebuilding of the old works. A new 75,000 cubic foot gas holder will be constructed and the mains throughout the city will be relaid and larger service pipes installed. The improvement will cost about $25,000, and work will begin next week.

SACRAMENTO, CAL.—One million dollars will be invested in the city of Sacramento by the Pacific Gas & Electric Company during the year 1911. This sum will be expended in erecting an auxiliary steam plant, in the improvement of the street railway service, in additions to the gas plant and in other betterments of the company's interests. The beginning of these expenditures has already been made and further work will be pushed as rapidly as possible. The plant for generating electricity by steam will of itself cost $500,000, exclusive of the lot upon which it will be located. The site has already been purchased and plans have been completed for the immediate construction of a steam turbine with an average capacity of 15,000 h.p.

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FIREPROOF SUBSTATIONS

BY C. F. ADAMS[1]

C. F. Adams

The problem of how to deliver light, heat, and power without "spilling" the goods en route, has always engaged the minds of transmission men.

Owing to the concentration of apparatus at substations, there are always a large number of possible "spilling" points centered there. Many of the earlier switching stations and small sub-stations came to grief before the importance of fire prevention was realized. A free high tension arc in a small substation is not a proper subject for close attention, in the station.

From a study of human impulse, the emergency switches are always located out of doors, and these are generally supplemented by high tension fuses, at stations where an attendant is not on continuous duty. For the past four years, one station after another has been rebuilt and constructed of fire proof material. Reinforced concrete is the material most employed in the more important points. Concrete barriers separate the high tension oil switches, and in some stations they are used as bus partitions also. For the moderate country station, the preferred structure is of galvanized steel mounted on a steel frame, the floor being of concrete.

The concrete station is found to be invulnerable as regards high tension arcs and flame. Galvanized steel stations provide an excellent ground path for a free arc, which generally centers on a limited surface.

A few holes the size of bird shot through the sheet steel is generally the limit of the damage in a steel building when high tension trouble occurs.

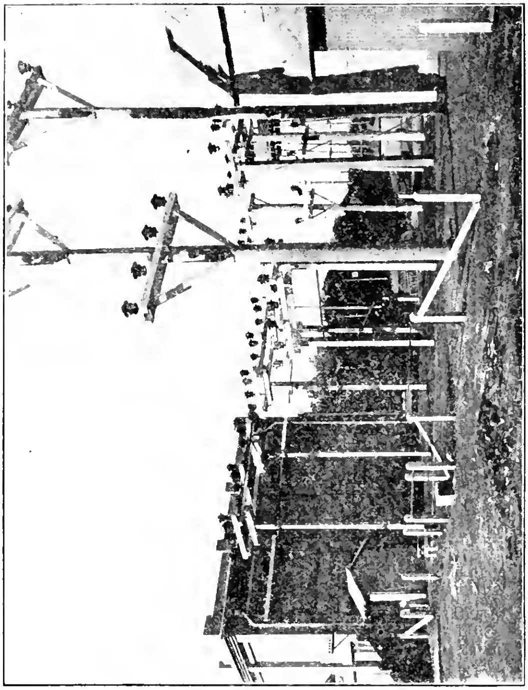
Our technical literature and the discussions of the Institute of Electrical Engineers devote many pages to the subject of fire risk from the use of oil type transformers. Many of the foremost engineers insisted that the station fire risk was directly proportional to the amount of oil involved. General experience always determines disputes of this nature, and the practice of the Pacific Coast engineers, in avoiding expensive transformer compartments, oil drains, and special transformer fire apparatus has been vindicated by time. Oil cannot burn unless it is very hot, or fed through some form of wick. You cannot overheat several hundred gallons of oil in a few minutes time.

Mountain View Substation.

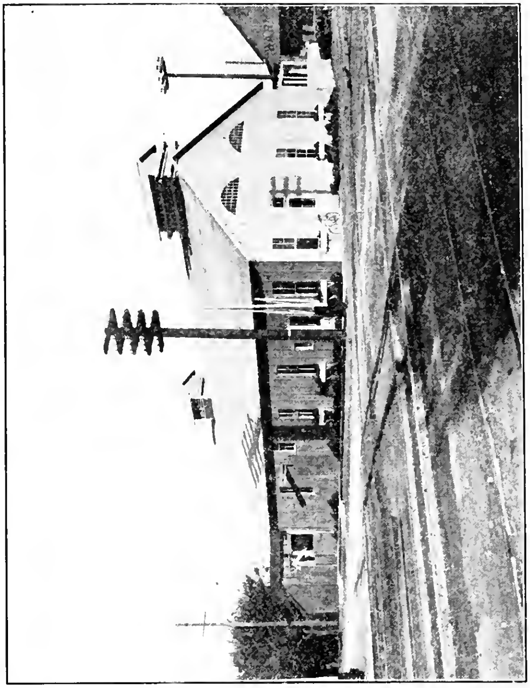
A proper fuse or automatic switch will protect a transformer against much damage from internal short circuit. The absence of external combustible material is the best protection against possible external heat. If there is nothing combustible in the structure of a station, transformers require no fire housings.

This general principle has governed the design of

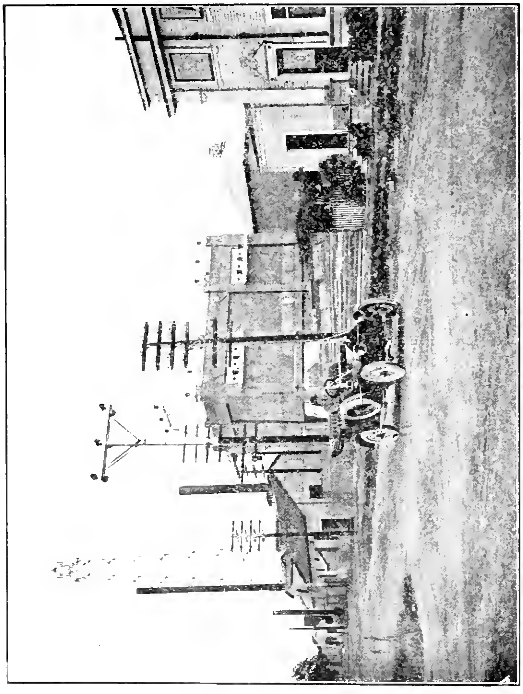
[1] Engineer of Electric Construction, Pacific Gas & Electric Company.



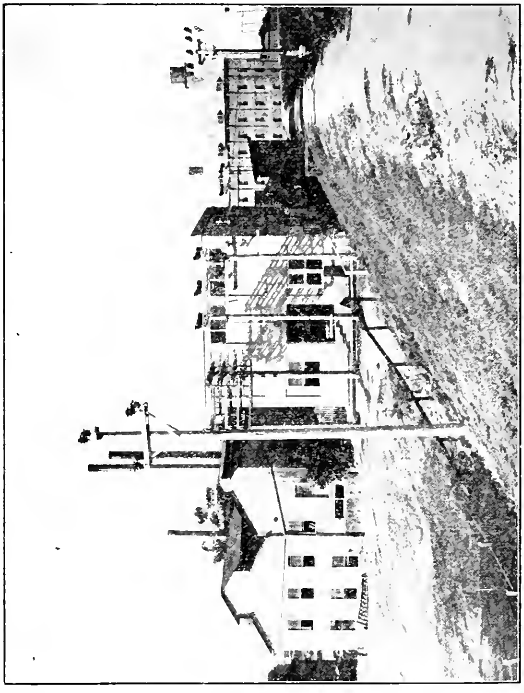
Chico Substation, Rear View.



San Mateo Substation, on the Railroad Near the Passenger Station.



Redwood Substation and Power-line Tower



Marysville Gas Works, Substation, and the Sperry Flour Mills.

stations and their internal arrangement. The accompanying photos show the external line and switching structures, as well as the character of buildings now in use by the Pacific Gas & Electric Company.

Redwood, Marysville, Chico and Mountain View have excellent examples of the compact concrete buildings. Hammontown has a galvanized steel structure, while the stations at San Mateo and Palo Alto, are housed in masonry structures, whose combustible material is limited to the roof only.

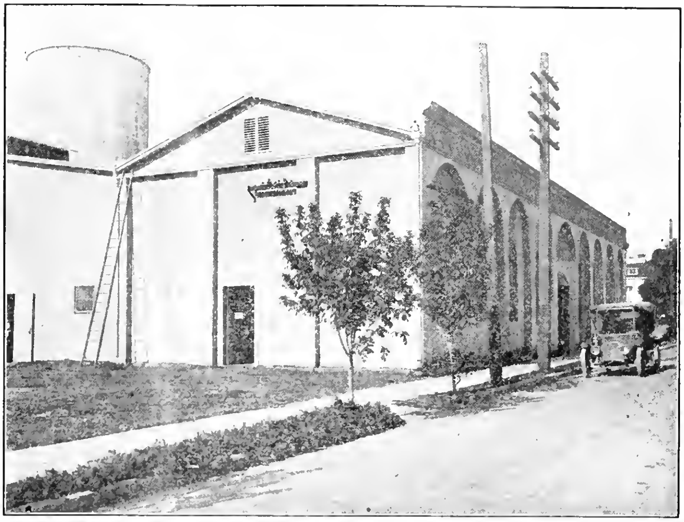
Of the above concrete stations, Marysville contains five sets of three-pole 60-kilovolt oil switches, being an important switching station. Its transformer equipment consists of six 500-kilowatt units, which supply current for six two-phase circuits for light and power purposes.

Chico station has 1700-kilowatt capacity of transformers, and is also the junction point for the lines of the Northern California Power Company.

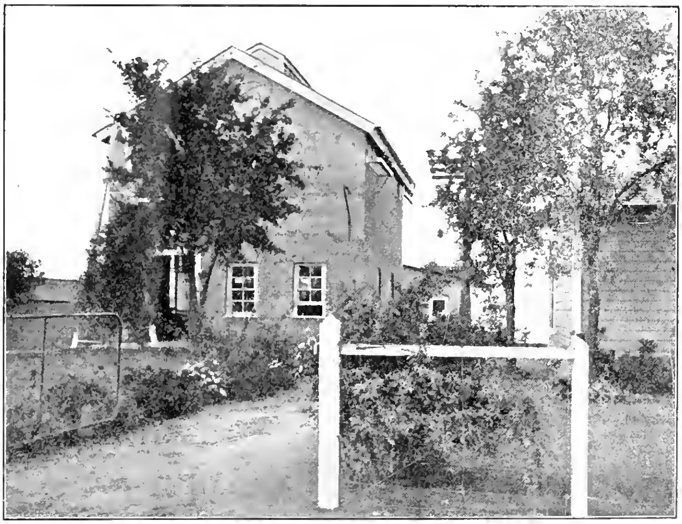
Mountain View station contains 1500-kilowatt capacity of transformers supplying current to Palo Alto and Sunnyvale. It is also an important switching station. The industry and taste displayed on the lawn and yard decorations have made this a "premium station," and the station interior is as well kept as the grounds.

Redwood City station contains six sets of 60-kilovolt oil switches, and a transformer equipment of 1500-kilowatt. Four distributing circuits are operated from this point.

The operating success which has followed the adoption of the fire-proof station is its best recommendation, and all future stations are being planned for the same permanence and high grade service.



Palo Alto Substation, Near the Railroad



Hammonton Substation Supplying Twenty Gold Dredgers on the Yuba River

PUBLIC UTILITIES COMMISSION PROPOSED IN UTAH.

The creation of a public utilities commission, with jurisdiction over all public service corporations in Utah, is authorized by a bill introduced by Senator Badger, of Salt Lake. The bill gives the commission executive powers over the corporations specified with reference to fixing standards of rates to be charged, adjusting differences and regulating the business of the corporations. The commission is to consist of three members, appointed by the Governor. Not more than two of the members shall be affiliated with the same political party. One commissioner is to be appointed for two years, another for four years and the third for six years. At the expiration of each term the successor of the original appointee is to be named for six years. One commissioner is to devote all of his time to the work and the other two part of their time

Oil burning boats to the number of 340 are credited to the port of San Francisco, according to the records of the U. S. Steamboat Inspectors' office, as compiled by John K. Bulger. The total tonnage of these vessels is 391,521 and their consumption of fuel oil is estimated at 25,000,000 barrels per annum.

ELECTRICAL STRIDES IN THE SOUTHWEST.

BY CHAS. H. PEIRSON.

Los Angeles is further advanced in the use of electricity than any other city in the world, according to the annual mid-winter number of the Los Angeles Times. Its people use more electricity per capita. Almost every dwelling, from the shack to the mansion, is equipped with electric lights. Electricity is used for more industrial purposes than elsewhere. Events of the past month indicate that the year 1911 will see it become the exclusive motive power for all transportation save transcontinental and long coastwise hauls. In agriculture electricity has taken a more prominent place than in any other industry, and for irrigation and bringing to the use of humanity great areas of productive land, it has proven so efficient that the expert minds devoted to its study do not hesitate to make startling predictions for the future.

The great era of the development of electric power by the private corporations operating in Southern California commenced in 1906, and continuing to the present time is chronologically as follows:

The bringing in of Southern California Edison Company's Kern River power plant with a capacity of 30,000 horsepower.

The completion of Southern California Edison Company's steam plant in Los Angeles, with a capacity of 16,000 horsepower.

Following this was the development by the Pacific Light & Power Company of its Kern River plant with a water-power capacity of 10,000 horsepower.

Next the Pacific Light & Power Company completed its steam plant at Redondo, with a capacity of 20,000 horsepower.

The Pacific Light & Power Company is now constructing a steam plant at Redondo with two turbo-generators of 16,000 horsepower each, or a total of 32,000 horsepower.

The Southern California Edison Company is now constructing at Long Beach what will ultimately be one of the largest steam plants in the world. It has an installation of eight turbo-generators of 16,000 horsepower each, with 128 boilers of 750 horsepower, giving a total capacity of nearly 150,000 horsepower.

The total of the power which has been developed by private corporations for use in Southern California since 1906 available for use twenty-four hours per day will, therefore, be seen to equal 80,000 horsepower, which is now in use for continuous service.

The capacity of electric generation from the waters of the Owens River is estimated by the aqueduct engineers as 64,000 horsepower available for all hours of the day. By storing the water-power during the early hours of the morning, it will be possible, however, for the waters of the aqueduct to generate a total output of 120,000 horsepower during the evening hour when the demand reaches its maximum.

Three events of predominating importance to those engaged in the electrical business and the public, have transpired during the year 1910. They are as follows:

The announcement a few weeks ago that the Southern Pacific is to electrify all of its suburban lines as well as lines leading to near-by cities, coupled with the prospect that electricity may be used as motive power for even longer hauls, changes materially the aspect of the generating proposition and puts a new phase on the question of supply and demand. The program announced for immediate electrification by the Southern Pacific Railway includes the following:

The coast line to Ventura (with perhaps an ultimate extension of the trolley system to Santa Barbara), 110 miles.

The line from Los Angeles to Ontario, including the line to Pasadena, and from Dolgeville to Duarte, and a loop between Savannah and Pomona.

Another part of the system planned to undergo similar transformation at an early date includes the line from Los Angeles to San Pedro and Long Beach, together with a system of tracks terminating in a double loop taking in West Anaheim, Anaheim, Tustin, Santa Ana, Newport Beach and Los Alamitos. The steam line projected to Santa Monica and built to the Palms is also to be electrified, affording a new outlet for trolley lines to the Arcade Station. The electrification of these steam lines will add about 300 miles to the 1000 miles of trolley trackage included in the lines taken over by the Southern Pacific.

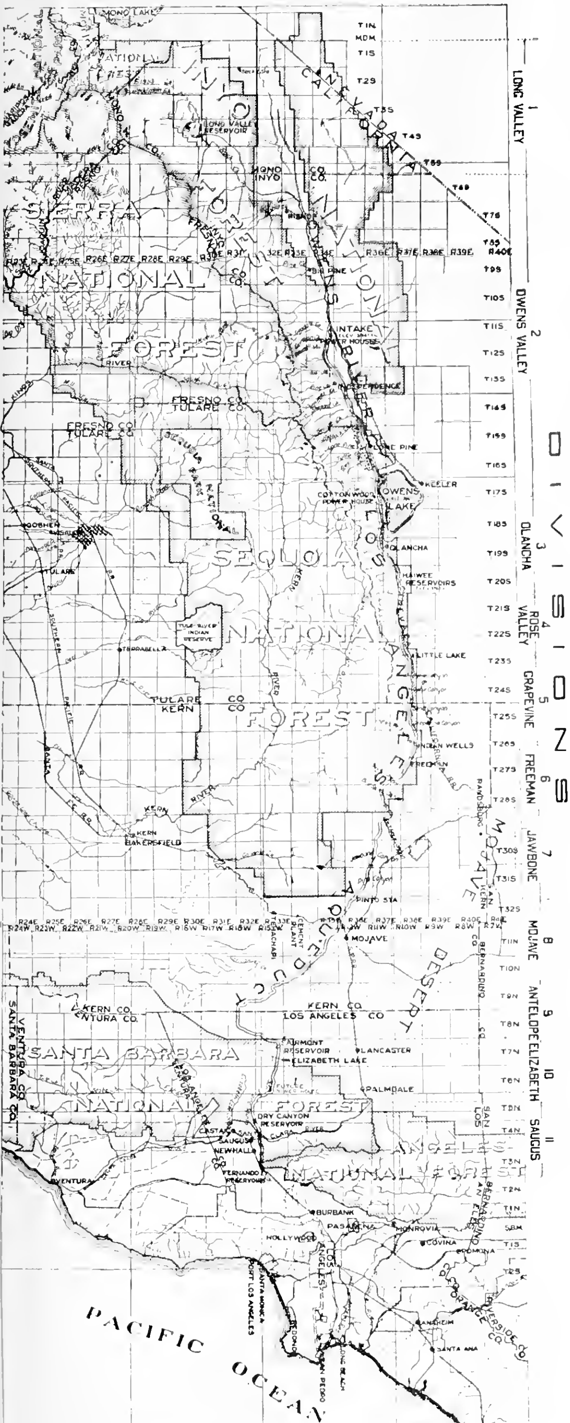
An electrical engineer conversant with the traffic on the lines which it is proposed to electrify and those which will probably be added to the program as announced, estimates that it will require approximately 40,000 horsepower per day to operate them. The estimated generating capacity of the flow of the Owens River Aqueduct is 64,000 horsepower, and it will thus be seen that the electrification of the lines of the Southern Pacific as above indicated will require electric power equal to about two-thirds of the entire available output of electricity from the Owens River, thus materially changing the basis of estimate of the available hydroelectric energy in Southern California.

Next in importance is the enormous appropriations decided upon by the electric companies for steam auxiliary plants. This construction, either under way or arranged for during the past year, will, upon completion, aggregate $8,000,000.

This seems remarkable in the face of the fact that the time is rapidly approaching when electric generation from the waters of the Owens River will be available. The answer is to be found in the fact that the officers, managers and experts of the private electric companies have learned by experience that service dependent entirely upon water-power generation is unreliable to the extent that it is subject to the destructive forces of floods, and washouts, and that long transmission lines are menaced by many forms of interruption. To guarantee electricity to merchants, manufacturers and large consumers, whose business is absolutely dependent upon the constancy of light and power, it is necessary as a business proposition, to supplement all hydroelectric energy by a battery of steam plants equal to keep the load up to its maximum demand in the event of any emergency.

The peak load for demand averaging between 5 o'clock and 9 o'clock in the evening also has to be forced up by steam-generated electricity.

It logically follows that in a possible contest for business between a system dependent entirely upon electricity generated by water and subject to the vicis-



Map of Los Angeles Aqueduct and Adjacent Territory.

situdes of weather, and a system which can guarantee the merchants and manufacturers that their stores would be lighted and the wheels of their industries supplied with power through auxiliary forces of steam generated, that the unsupported water-power would suffer in competition.

Electric power is already being generated from the upper waters of the Owens River. Thus far it is used principally for construction, and a small supply is being sold for lighting the village of Independence, Inyo county.

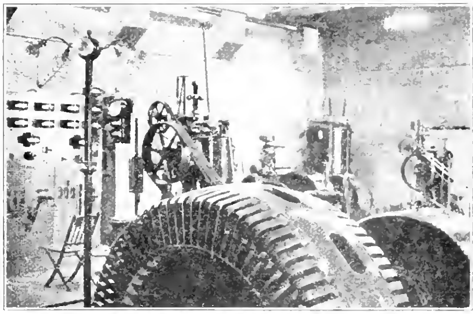
E. F. Scattergood, the electrical engineer of the Aqueduct Commission, says that the city will have at its seven power sites when the development of the Owens River power is completed, available at a central substation, a net average of 64,000 horsepower, and by the use of reservoirs and regulating devices, it will be possible to deliver for a short period during any twenty-four hours up to a peak load of 120,000 horsepower. This will be accomplished by holding back the water which would flow through the canal during the early morning hours and turning it all loose during about one hour in the early evening when the demand for current for lighting is greatest.

The general plan of the development of electric power along the line of the aqueduct, and its transmission to Los Angeles and vicinity is, in the opinion of the Consulting Board of Engineers, a thoroughly practicable scheme involving no engineering problem which should not permit of successful solution, and promising a reliable source of power, destined to find a ready market at prices advantageous to Los Angeles. Taking at points of departure the aqueduct's surveys for amounts of fall and the reports of stream flows and capacity on which the general aqueduct design is based, the board finds that the total amount of power which can be developed in the vicinity of Los Angeles and ready for sale at step-down voltage is approximately 64,000 horsepower for twenty-four hours to a maximum delivery of 120,000 horsepower. This is substantially 30 per cent in excess of the estimate made by the first Board of Consulting Engineers. The power available at Cottonwood and Division Creek amounting to some 4500 kilowatts was not contemplated or included in the earlier estimates. Final surveys for location with special reference to power development have permitted of more advantageous locations of power sites, thus securing higher heads and a corresponding increase in the power available without increasing the cost of the aqueduct construction. The estimate of cost is less in very marked degree than the average cost of hydraulic power development and installation elsewhere on this coast, and under generally similar physical conditions and surroundings. In the case of the aqueduct project the primary division works are a part of the aqueduct, and the water is furthermore carried along the line in close proximity to the power sites. Under these circumstances the cost of hydraulic development for power in connection with the aqueduct should naturally be somewhat less than for the development of water-power independently.

The principal power sites are in relatively close proximity to the city of Los Angeles, and are at the

same time relatively accessible for the transmission and installation of equipment. All extra charges for diverting water from the natural aqueduct line and handling it along the power line has been charged to power development, the same as in the case of diversion from the course of a natural stream for power purposes. In brief, in the distribution of charges between the aqueduct and power project the former is charged only with such features as should be directly necessary for passing the water as an aqueduct.

The experts of the Board of Consulting Engineers assumed that under usual conditions the average aqueduct flow per day would be at the rate of 400 cubic feet per second and that this flow must be maintained or at least permitted whether power is developed or not. With this steady flow the capacity of the power sites at San Fernando and at Haiwee Dam, together with those at Cottonwood and Division Creek feeders, with an average stream flow of twenty second feet and eight second feet, respectively, will provide for a steady development of some 14,000 kilowatts.



Cottonwood Power House Two 750-kw. Generators Power All Utilized for Construction Work.

To provide for the variable flow at these sites while at the same time assuring the necessary continuous daily average flow through the entire length of the aqueduct, provision is made for aqueduct storage reservoirs above and below these sites. The function of these reservoirs will therefore be to permit of the regulation of supply in accordance with the demand, while in addition they will have a capacity sufficient to provide a guarantee against ordinary interruptions of service due to incidental repairs on the aqueduct line between the Fairmont and Haiwee reservoirs.

Regarding the program for the development of the Owens power, the consulting board recommends a progressive development at such a rate as the growth of the power market may justify. As a first step, the installation of all such portions of the equipment as may thus be required for the aqueduct project by itself together with the full development of one or more power sites as further study may indicate, is suggested.

The cost of constructing the generating plant as above outlined, without allowing for a distributing system in Los Angeles or elsewhere will, according to the Consulting Board of Engineers, amount to $7,200,000.

The people of Los Angeles and Southern California are probably the greatest users of electric light in the world. In the first place, their homes were built to be lighted by electricity; there was little antique gas piping and fixtures to be removed because the great construction period of this city dates from the time that electricity was accepted by the world as its illuminant. The number of houses in Los Angeles and its environs where electricity is used for lighting is approaching the 100-per-cent point.

In the second place, the people of Los Angeles have now the cheapest electricity in America—probably in the world. They have always had their electricity far below the cost of other similarly conditioned cities. A tabulation compiled from correspondence obtained from fifty-seven cities shows the average lighting rate to be 11.4 cents per kilowatt hour, as against 7 cents in Los Angeles, this city thus having a rate 40 per cent less than the demonstrated average. The following will show the reader what other people are paying for their electricity in cities and towns which have obtained their growth, and the extension of whose distributing system is practically complete, while Los Angeles is just beginning to grow and its distributing system must be extended to permit of growth:

New York, N. Y., population 3,000,000, maximum rate 10 cents; Brooklyn, N. Y., 1,600,000, 12 cents; Rochester, N. Y., 210,000, 8 cents; Buffalo, N. Y., 415,000, 9 cents; Philadelphia, Pa., 1,500,000, 13.5 cents; Pittsburgh, Pa., 600,000, 10 cents; Washington, D. C., 350,000, 10 cents; Baltimore, Md., 650,000, 10 cents; Boston, Mass., 630,000, 11 cents; Providence, R. I., 215,000, 12 cents; Hartford, Conn., 105,000, 11 cents, (cash discount of 5 per cent); Portland, Me., 65,000, 9 cents; Manchester, N. H., 70,000, 12 cents, (cash discount of 5 per cent); Burlington, Vt., 20,000, 10 cents; Richmond, Va., 116,000, 10 cents; Raleigh, N. C., 15,000, 13.5 cents; Chicago, Ill., 2,600,000, 12 cents; Milwaukee, Wis., 375,000, 12 cents (cash discount of 5 per cent); Madison, Wis., 20,000, 14.5 cents; Des Moines, Iowa, 100,000, 12 cents, (cash discount of 5 per cent); Indianapolis, Ind., 250,000, 10 cents; Topeka, Kan., 50,000, 9 cents; Memphis, Tenn., 200,000, 10 cents; Louisville, Ky., 290,000, 8.4 cents; Detroit, Mich., 450,000, 12.6 cents; Grand Rapids, Mich., 110,000, 8 cents, (a penalty of 10 per cent if not paid promptly); St. Paul, Minn., 235,000, 13.5 cents; Minneapolis, Minn., 310,000, 10 cents; Kansas City, Mo., 375,000, 10 cents; St. Louis, Mo., 750,000, 12 cents; Natchez, Miss., 15,000, 13.5 cents; New Orleans, La., 375,000, 17.1 cents; Birmingham, Ala., 40,000, 10.4 cents; Little Rock, Ark., 60,000, 13.5 cents; Atlanta, Ga., 150,000, 9 cents; Newark, N. J., 350,000, 10 cents; Cleveland, O., 550,000, 12.5 cents; Cincinnati, O., 460,000, 10 cents, (cash discount of 5 per cent); Guthrie, Okla., 20,000, 15 cents; Wheeling, W. Va., 50,000, 13.5 cents; Sioux Falls, S. D., 15,000, 18 cents; Fargo, N. D., 15,000, 10 cents; Denver, Colo., 225,000, 8 cents; Boise, Idaho, 10,000, 15 cents; Butte, Mont., 50,000, 11.8 cents; Omaha, Neb., 155,000, 14 cents (5 per cent cash discount); Seattle, Wash., 200,000, 9 cents, (10 per cent penalty if not paid promptly); Spokane, Wash., 50,000, 10 cents; Salt Lake, Utah, 100,000, 10 cents; San Antonio, Tex., 125,000, 14.5 cents; Houston, Tex., 100,000, 13 cents, (5 per cent cash discount); Cheyenne, Wyo., 20,000, 12 cents; Albuquerque, N. M., 10,000,

13.5 cents; Portland, Ore., 275,000, 15 cents, (cash discount of 5 per cent); San Francisco, Cal., 500,000, 9 cents; Sacramento, Cal., 55,000, 9 cents; Oakland, Cal., 150,000, 9 cents.

One million electric lights glow in Los Angeles every night, as shown by the connection records in the city electrician's office.

One thousand and sixty-four electric motors were turning the wheels of industry within the city at the close of the last record year.

It can be assumed that so far as electric lighting is concerned, that its use is almost abreast with the population, and that its increase hereafter will be commensurate with the increase in population. Something over 95 per cent of the total possible residential and business lighting is now done by electricity, but the increase in the use of the motors presents a field of wonderful possibilities. It is daily displacing the steam and gasoline engine for manufacturing purposes, and is making the establishment of manufactories an undertaking requiring far less capital than in the days of the inevitable tall chimney, the costly steam boiler, and the solidly constructed building which was obliged to stand the rack of the steam engine. When Los Angeles takes its place in the ranks of great manufacturing cities of America, the electric motor will be the principal factor in accomplishing the achievement.

The completion of the Panama Canal will, of course, open our ports for the importation of cheaper raw material and the exportation of finished products. It will bring directly to our port the skilled and accomplished textile workers of the Old World who now drift from Castle Garden to the manufacturing centers of New England and the South. The cotton growing industry of the Imperial Valley will become an important domestic source of raw material; push the button, and the electric motor will do the rest.

The increase in the use of electricity for light and power, as shown by the records of the office of the city electrician, since the year 1905 will closely conform to the increase of its use in other cities and towns in Southern California. These records are as follows:

FOR USE AS LIGHTING.

Number of 16-c.p. lamps covered by permits issued during year	1905-6	155,613
	1906-7	135,744
	1907-8	112,299
7 months	1908-9	79,124
	1909-10	175,840

FOR USE AS POWER.

Number of motors covered by permits during the year	1905-6	783
	1906-7	1,017
	1907-8	698
7 months	1908-9	511
Year ending July 1,	1910	1,064
Capacity of motors in horsepower	1906-7	5,240
	1907-8	2,675
	1908-9	2,105
	1909-10	4,817

Fixation of atmospheric nitrogen by arc discharge requires about 28 kw.-hours for every pound of nitrogen bound as nitric acid, whereas 6.4 kw.-hours suffices for one pound of nitrogen held in the form of calcium cyanamide.

INDUSTRIAL ACCIDENTS.

Industrial accidents in the United States take an annual toll of life and limb far exceeding the killed and wounded of several great military campaigns. The statistics given by the Bulletin of the Bureau of Labor for 1908, which must be regarded as incomplete because of the failure to report fully these accidents, show a yearly mortality of between 30,000 and 35,000 adult wage earners alone, and the non-fatal injuries inflicted will roll up the total by at least an additional 2,000,000. These and other arresting statements are made by Mr. John Calder, manager of the Remington Typewriter Works, Ilion, New York, who will at the New York monthly meeting of the American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York, Tuesday evening, February 14th, present a brief for the Mechanical Engineer and the Prevention of Accidents. Mr. Calder believes much can be accomplished by a movement on the part of the profession which has to deal so largely with the planning and working of industrial machinery. Prevention, not cure, is the theme of the paper, which analyzes the causes of those accidents regarded as preventable and describes various devices for guarding equipment and processes, drawn chiefly from the writer's experience in plant management. Mr. Calder considers that one-third of the present rate of mortality can and should be eliminated by such devices.

The causes of preventable accident are, in Mr. Calder's belief, chiefly ten, ignorance, carelessness, unsuitable clothing, insufficient lighting, dirty and obstructed work places, defects of machinery and structure, and absence of safeguards, and with each of these he deals in turn, showing how they may be eliminated. Engineers are largely responsible in these cases since to them usually falls the control of such plants, and the matter should be made one of scientific study by them.

Under the head of safeguarding, the author has many interesting views of equipment and machinery, showing the use of such devices on gears, steam turbines, lathes, cotton carders, rolling mill engines, transmission tubes, belts, variable diameter converting saws, log saws, constant diameter overhung saws, press feeds, calendaring machines, grinding wheels, etc. He also takes up in detail especially dangerous machines and processes which present difficult safeguarding problems for the engineer. Under the first head he presents only four, which may be regarded as typical: wood working saws and cutters, punches and presses, rolling machinery of all kinds where hand feeding is necessary, and emery and other grinding wheels, all of which he fully illustrates. Dangerous processes where the risk is not purely mechanical involve enforcing of rules, such as never to clean a machine while it is in motion; the placing of machines in locations that will not endanger passers-by; protection of open stairs and gangways, of open vats containing chemicals, and of vessels which are likely to burst. The author further recommends the continual inspection of these safeguards, the education of the workmen rather than the prevalence of many "take warning" signs which go unread, and providing of first aid services in the case of every accident.

POSSIBILITIES OF LOGGING BY ELECTRICITY.

In an article in the Pacific Lumber Trade Journal, Seattle, Wash., Frank Mackean describes the application of electricity to the homely task of logging. He assumes that there is a small brook near the tract of timber, and that upon examination it is found to be 4 ft. wide, 1 ft. deep and flowing 4 ft. per second. There is hardly a good sized body of timber on the coast that does not boast of one or more of such streams, quite often many times larger.

The topography of the country is such as to make it comparatively easy to find a place in the stream where the banks are high and the gorge or bed of the stream is narrow enough to locate the dam or diversion works. This point should be selected with a view of a good foundation for these works, shale, clay or rock being necessary to make the structure reliable.

The next step is to determine the head, or the height in feet, that can be utilized in the fall of the stream. As a hypothetical case assume that in its course of 1000 ft. down the valley the brook falls an even 100 ft., and that the diversion works has raised the water another 10 ft. above the bed of the stream, hence, between the level of the pond and the site of the power plant is a difference of 110 ft. Water-power is proportional to the amount of water in a stream, times its fall in feet, reduced to foot pounds and then to horsepower.

In the case of the supposed stream above the value is reduced to horsepower as follows:

Find a place where the stream is fairly straight and has a well defined channel free from boulders and obstructions for 50 ft. or a 100 ft. of its course and measure off one of them, marking them by a stake. In this stretch at an average width point of the brook measure the width of the stream, which will be found 4 ft. wide, then every 6 in. across the stream measure the depths and by adding the seven measurements together it will be found that the average depth of the stream is 1 ft. The next step is to determine the velocity of the flow. To do this fairly well a common one-half pint flask, or a 1 or 2 lb. bottle, will be found good, but a stick about 6 in. long and 1 or 2 in. thick with a small stone tied on one end will answer the purpose. In either case the float should be so ballasted as to ride well immersed in the water. With watch in hand time this floating bottle or stick between the points marked on the bank of the stream by trying it three times and then calculating this time by the average of the three readings. We will assume that in this case it is 4 ft. per second or that the float traveled the 100 ft. in 15 seconds, or the 50 ft. in 7½ seconds. We are now in possession of the data from which to calculate our power. We do this by multiplying the width by the depth, equals 4, by the velocity of the stream, 4 ft. per second, equals 16, which is the number of cu. ft. per second in the stream, and this multiplied by 60 equals 960 cu. ft. per minute. The power factor is further determined by multiplying the head or fall as represented in this case as 110 ft. by the 960 which gives us 105,600 cu. ft. of water. As the weight of one cu. ft. of water is 62½ lb., we reduce this water to foot-pounds by multiplying the two, which gives us a quotient of 6,600,000 foot-pounds. As the equivalent of one horsepower is 33,000 foot pounds we divide the first by the last with a result of 200 horsepower. This is the theoretical horsepower only. As a matter of fact, the transfer of this force into power entails losses, and actual practice shows that these losses average fully 30 per cent of the total theoretical horsepower of the stream. These losses are found in the friction of the water in the flume, pipes or races; the water-wheel; and also in the electrical machinery and wire line used to distribute the power. In this case we will have lost 60 horsepower, leaving us 140 horsepower available for real use.

The next step is the conversion of this power, which is accomplished as follows:

Assuming that the improvement is to be made solely for the purpose of logging off the land and in no sense to be permanent; the diversion dam can be constructed of logs, built of the gravity type planked on its upper slope with tongue and grooved 2-inch flooring and the intake pipe placed at least 3 ft. below the proposed dam water level. A spillway over the crest of the dam or around it should be provided, ample to carry any flood waters that may come down the stream, and care should be used to see that the discharge in the stream is far enough below the dam to not undermine it.

The next step is the pipe line. As we have 16 second feet of water, and 6 ft. per second is about the economical limit of velocity in a pipe line we will require an 18 in. pipe to carry the water down the 1000 ft. of slope from the dam to the power house. Time was when the placing of a continuous wood stave pipe was a specialty that was taxed against the user at a rate that left a question as to its final economy, but the planing mill and local sawmill have made it a simple matter to get out the material for such a pipe as above noted. By taking a common rough 2x4 and planing it on two edges and one side, beveling the edges slightly, the staves can be easily prepared for this pipe. To secure the necessary bevel draw an 18 in. circle on a piece of paper, then another one 22 in. or 2 in. from the other; take a pair of compasses or dividers and space the outer circle into 18 equal spaces. Then from each scribed point on the circle draw a straight line to the next point and so on clear around the circle. Then from each of these points draw a line to the center. Then from the intersection of the inner circle and the radial lines draw another set of lines. These will divide your circle into 18 segments having plane sides. One of these segments is the pattern for planing your staves and allowing ¼ in. for planing in thickness, another ¼ in. for planing two edges will give us for our stave dimensions as finished, 3⅝ in. on the outer side and 3⅛ in. on the inner planed side, the edges being each beveled at the same angle. One sixty-fourth of an inch is allowed in these calculations and dimensions for the shrinkage of the wood which should be cut from fir flooring logs, free from knots that run through or may come on the edges of the beveled stave, and should be put in the line fresh from the mill and planer, green. The bands are made simply by cutting a 4 in. thread on ⅜

in. round iron rods and swedging a head on the other end and bending them around the formed pipe and using a lug to make the connection, using a socket wrench to set up the nuts and thus tighten the round iron hoop. These should be spaced from 4 in. to 1 ft. apart as the pressure comes on the pipe line. All stave joints or ends should be made by taking a handsaw and sawing a scarf across the end of the stave 5/8 in. deep and inserting an 1¼ in. wide by 3⅜ in. long strip of No. 16 gauge hoop iron into it and the stave next following it, also similarly sawn. Care should be used to see that the hydraulic gradient is not departed from in laying the pipe line or you will have a severe loss of head in your plant.

The water-wheel may be of the horizontal turbine type fitted with an automatic governor, and for the particular development here outlined should be a 12 in. wheel with steel case and steel draft tube, and set 8 or 10 ft. above the tail race or ditch carrying the water away from the wheel.

The next step is the power house, which can be built the same as the other camp buildings, of rough lumber. The only extra care needed is in preparing the foundation for the water-wheel and electric generator, which should be firm and well set. Concrete could here be employed to good advantage even for a temporary plant, but logs cribbed and drift bolted will answer if properly placed. The generator should in this case be a 150 h.p. direct current machine of the multipolar type, 600 volts, and direct connected to the water-wheel. This is important, as a compact installation is necessary and one that is as near "fool proof" as possible and the entire plant should be as nearly self-regulating as it is possible to make it. The switchboard, a marble slab set on an iron frame at one side of the room housing the power plant, should carry one or more switches, an automatic circuit breaker, and a voltmeter and an ammeter with a pilot light, and a rheostat. The wiring can be either single or double circuit as the conditions may warrant. By grounding one side of the electric machine and one side of the motors, one wire is all that will be required for operating the system. The wires should be rubber covered and double braided to protect the insulation from abrasion and then a cheap wooden bracket and glass insulator can be tacked to the trees to get it to the point of usage.

The next step in the equipment is the electric donkey. This is substantially the same in the arrangement of drums and drum control as the steam outfit, but the frame is made only long enough to carry the drums, and under the main shaft (which in the steam donkey is the engine shaft) the iron-clad electric motor is bolted in and a gear is keyed to it and meshes into the pinion on the motor shaft. Under the haulback drum is another small drum which is fitted with two friction contacts and carries coiled thereon a duplex braided specially insulated stranded electric cable which supplies the donkey with electricity. With this equipment the machine can be moved around in the woods by its own power exactly the same as the steam outfit.

The cut-off electric saw consists of a small one-half horsepower motor geared to an 8 ft. cross-cut or falling saw with a frame fitted with hinged tripods that are set up on the ground and fastened to the tree to be felled, in such a position as to allow the saw to work properly. The current is supplied to the motor by a feed wire of the same design as that on the donkey. One man only is required to operate this and in thick timber he could easily attend to three as well as one. This outfit will do the work of five men easily. The same saw can be used to "buck" the trees into logs, as the tripod is adjustable to make the saw operate either horizontally or vertically.

The foregoing makes up a complete electric logging outfit from the brook to the skid road or delivery point of the "yarder"; and in this article we propose to confine ourselves to this division of the logging problem only.

The next and most vital question to answer and digest is the cost of the electric system of logging.

Intake and dam	$ 50.00
Pipe line, 18-inch wood stave (continuous), laid	640.00
Water-wheel, installed (200 h.p. capacity)	300.00
Power house, shed construction	150.00
Electric generator and station instruments (d.c.)	950.00
Wiring (say ½ mile)	400.00
Total cost, ready to operate	$2,490.00
Electric donkey, complete, with 50 h.p. motor geared 8 to 1, with same drums and equal to a 9x10 in. steam outfit and guaranteed to do the same class of work	950.00
Electric falling and bucking saw, takes one man to run it; will do the work of 5 men	150.00
Complete equipment up to roader point in logging operation	$3,590.00
To this amount should be added for 65 h.p. "roader" donkey, the sum of	1,150.00
Extra line construction for same	250.00
Making the total outlay for a complete electric outfit to deliver logs, say 3000 feet	$4,990.00

To operate this outfit will require the following fixed costs, to get an outfit of 80,000 feet of logs per day:

Interest on investment, at 10 per cent. to cover contingent extras, $490 per year, or per day of 300 working days in year	$ 1.66
Depreciation, 5 per cent	.84
1 Electrician at power house	4.00
2 Electricians at donkeys ($4.00 each)	8.00
2 Choker men ($3.00 each)	6.00
1 Sniper	3.00
1 Chaser	2.50
3 Rigging slingers ($3.50 each)	10.00
1 Signal man	3.00
1 Faller and bucker to operate electric saw	3.50
	$39.00
To this add another $2.00 for repairs especially chargeable to the electric equipment	2.00
And we have as the total daily cost of operating	$41.00

Or a cost of 51¼ cents per thousand from the tree to the water, on 3000 foot delivery.

Against this electric showing we have the digest of logging costs by steam under average conditions as published in the October, 1910, "Timberman," by Mr. J. P. Van Orsdel, of Portland, logging engineer:

Cost of falling and bucking by hand, 1000 feet to log, average	$0.55
Yarding same, 900 ft. haul, 1000 to log, average	.65
Roading same, 3000 ft. average haul	.30
Total cost per M	$1.50

He gives the capacity of the machines at from 50 M. to 75 M. per day of 10 hours.

He also gives the crews for this daily output, as follows:

Two sets fallers, three buckers.

For the yard engine crew he gives one driver, one firemen, bucker, one chaser, one hook tender, two rigging slingers, one swamper and sniper, and he figures their time at $26 per day.

His roader crew is given as one engineer, one fireman, one wood bucker, one chaser, one grab man, at a cost of $32.50 for labor and upkeep, etc.; so we will have to assume that the same schedule of wages has been used as for the yarder crew. This would make the labor account as follows:

Engineer, $4.00; fireman, $3.50; bucker, $3.00; chaser, $2.50; crab man, $3.00, making a total of $16 per day, which certainly shows a large allowance.

In his analysis of the upkeep of the yarder he also allowed $10 per day. There is a wide division of opinion as to these costs and we feel inclined to split them in half to arrive at the comparative figures.

4 Fallers, at $3.00 each	$12.00
3 Buckers, at $3.00 each	9.00
Yarder crew	26.00
Roader crew	16.00
Yarder upkeep (½ estimate)	5.00
Roader upkeep (½ estimate)	8.25
At a total daily cost of	$76.25
As against the electric cost of	41.00
Leaving a net daily saving of	$35.25

One manufacturing company claims a saving of $250 per month per donkey as against steam equipment, and the cost shows simply an adaptation of a steam outfit which was not as good a showing as can be made with an outfit such as we have outlined.

The prime factors in favor of the electric rig, are its wonderful flexibility, thus saving fully 50 per cent in the wear and tear of your rigging and machinery, its speed in operation and the great saving in labor that it makes. We have frequently heard the logger assert that the logs sawed up for wood for his donkey were of no particular value, but personal investigation has shown that they will average No. 2 logs and this will make the timber consumption on the basis of the value of this grade for the roader and yarder per day at least $12; add to this the wages of the two firemen, $7 per day, and the one-half time of one wood cutter and one full time at $4.50 per day. Add to this the additional cost of the wear and tear on the machinery caused by the use of steam and you have a convincing array of comparative figures in favor of the electric outfit.

But the usefulness of this great power does not stop in the logging camp here. The blacksmith can use it to weld his iron, the cook can use it in an electric cook stove that can be built to provide food for 30 men for the cost of a common range, and save time and money every turn of his work. The tram road can be fitted with a motor car to haul logs to the connecting railway or tide water or mill and all at no additional cost for the electricity, as 55 h.p. for the bucking and falling and yarder outfits and 65 h.p for the roader outfit leaves a margin of 20 h.p. for these camp economies.

Keen intellects are ever busy striving to shave a dollar here and a cent there from the cost of harvesting the rich yield of fir and cedar from the hills and valleys of this wonderful country and modern engineering has furnished the key to the greatest saving of them all by showing the logger how to make the tumbling hillside brook saw down his trees, with an electrically driven motor saw, "buck" them into logs by the same rig, and then "yard" or assemble them with the electric "donkey" to the skid road, fore-and-after or the electric tram, where a similar electric "donkey" delivers them to the mill, connecting railway and waterway, with a celerity, speed and economy that is at once the marvel and delight of the lumberman and expert woodsman.

In conclusion, the advantages of the freedom from danger of fires is one of the greatest points in favor of the electric outfit, and another great source of saving is that no water supply is needed for the donkeys.

LUBRICATING OIL.

The report of the use of lubricating oil in the electric and air compressor plants at the Panama Canal during the month of November shows a marked advance in economy in the use of oil in these plants, and a favorable record as compared with lubrication of similar plants in the States.

In the air compressor plants at Rio Grande, Empire and Las Cascadas there are 14 compressors; rated horsepower of each compressor, 425; steam pressure, 125 pounds, steam end of engines, double cylinder, simple; air end, double cylinder, cross compound; area of two steam cylinders, 9.42 square feet; area of high pressure air cylinders, 9.42 square feet; area of low pressure cylinders, 15.17 square feet; speed of compressors, from 127 to 137 revolutions per minute. All engines are equipped with individual lubricators on steam cylinders, and on each valve on the air end. The return oiling system is in use on all bearings, and engine oil is filtered before returning to the supply or pressure tank. The reports for each plant show:

Rio Grande—Valve oil used, 27¼ gallons; revolutions per gallon, 275,332; square feet of area rubbed over per pint of oil, 1,296,752. Air compressor oil used, 37 gallons; revolutions per gallon of air compressor oil, 202,770; square feet of area rubbed over per pint of oil, 1,246,516. Stationary engine oil used, 33¾ gallons; revolutions per gallon of stationary engine oil, 222,481. Plant of five compressors runs 10½ hours per day, except Sunday.

Empire—Valve oil used, 71 3/10 gallons; revolutions per gallon of valve oil, 256,577; square feet of area rubbed over per pint of valve oil, 1,208,492. Air compressor oil used, 73½ gallons; revolutions per gallon of air compressor oil, 248,723; square feet of area rubbed over per pint of air compressor oil, 1,529,064. Stationary engine oil used, 84½ gallons; revolutions per gallon of oil, 216,346. Plant of five compressors runs 22½ hours per day.

Las Cascadas—Valve oil used, 25 gallons; revolutions per gallon of valve oil, 256,732; square feet of area rubbed over per pint, 1,209,188. Air compressor oil used, 28 gallons; revolutions per gallon, 229,224; square feet of area rubbed over per pint of oil, 1,409,154. Stationary engine oil used, 40 gallons; revolutions per gallon, 160,456. Plant of four compressors runs 10½ hours per day, except Sunday.

The consumption of oil at Balboa and Empire electric plants was: Balboa—Valve oil, 33 gallons; stationary engine oil, 20 gallons; air compressor oil, 10 gallons. Empire—Valve oil, 17 gallons; stationary engine oil, 15 gallons.

GAS-PRODUCER ENGINES IN MEXICO.

There is a growing market in the San Luis Potosi district for suction gas engines, otherwise known as gas-producer engines, and the field is being cultivated by European manufacturers with more assiduity than by Americans. These plants are coming into use for pumping, ice making, small electric light plants, milling, and general manufacturing, and are replacing small steam engines. The efficiency and economy of the producer engine make it most suitable for this district, where fuel is expensive, and where the saving in water is also worth considering. It is estimated that the production of 100 horsepower by suction gas engines costs but one-third of steam power, and that such an engine, costing $7500 gold, can be run at a saving which will pay the first cost in less than two years. This type is peculiarly adapted to conditions on this plateau, where no water power is available, where small plants are desired at isolated points, and where economy is of vital importance.

Manufacturers in the United States, where power is cheap and readily rented, can scarcely realize that here it is a necessity in character but a luxury in price. If this whole district is to be developed and industrially modernized it can not be done with steam or with steam-produced electricity, or with large central plants, but with the suction gas engine. The United States is the logical source of supply for these engines, but it must be said that American manufacturers have not maintained their customary and rightful superiority in the development of this form of plant, which is largely a product of the past 10 years.

A steam engine cannot be sold to an importer here who can afford to buy a gas suction engine and who knows its capacity and results. The fact that the demand for these engines is being largely supplied by others, should be sufficient notice to American manufacturers that they are slighting an opportunity in a line in which they should lead the world.

The demand here is for plants of from 25 to 500 horsepower. Up to 200 horsepower single engines are preferred; above 200 horsepower separate units are found practicable, although these engines have been installed up to 650 horsepower.

It is to be noted that at this altitude (6000 feet) there is a diminution of from 18 to 20 per cent in efficiency, as compared with results at sea level. The engine must be heavy enough to absorb all shocks, probably not less than 18 tons for 100 horsepower; it must be accurately fitted in all its parts, and the strength and weight of parts must be adapted to the strains to be put upon them. Finally, the plant must be sold upon terms to allow the purchase price to be paid out of the saving effected by its use. German firms have in some cases allowed three years for full payment, or, as one dealer says, "they allow all the time asked for."

In an engine for this market reliability is the prime necessity; repairs and waiting for parts are exceptionally embarrassing; while simpler parts can be made in this city, it requires time, and suspension in an irrigating or water-supply plant is very serious. The planter, miner, or manufacturer will not take chances on his plant breaking down, if he can help it.

The American manufacturer is accustomed to making engines for localities where fuel is cheap and labor high; here these conditions are reversed, fuel is high and labor low, and the points needing power are isolated and processes intermittent, so that power in wholesale quantities is impracticable. The price of fuel is a handicap to power-producing processes on one hand, and the low price of labor further cuts down the margin of economy in machinery. Power must be economically produced in quantities to suit the demand in order to show a saving over hand labor.

A large machinery house in San Luis Potosi recently imported a small ice-making plant from the United States, but was obliged to buy the engine in Europe, much against its inclination, as the house is American, and has installed eight of these plants in this territory. There is much American machinery that meets little competition here, but the case is different with gas-producer engines.

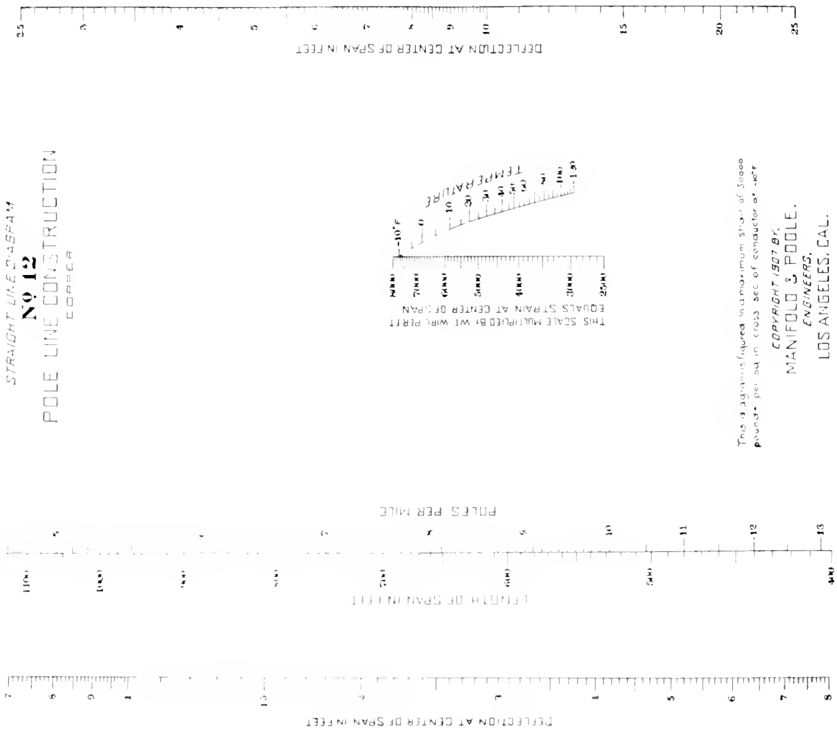
The German selling method is especially effective. They give their agents much discretion in the matter of credits, guaranties, and prices—in fact, the German agent is more than a salesman of these engines; he has administrative discretion; he is not tied down to rigid net prices; he can meet conditions to a large extent. Further, when he has a serious prospect of a sale and needs help, his firm sends an expert engineer to assist in demonstrating the plant, and without expense to the local agent. On the other hand, the American manufacturer quotes a net price at factory, with short credit, if any, and a guarded guaranty, the result being that the agent is left no freedom to negotiate. This gives the customer a strong impression that he is not dealing with a fully authorized representative of the firm.

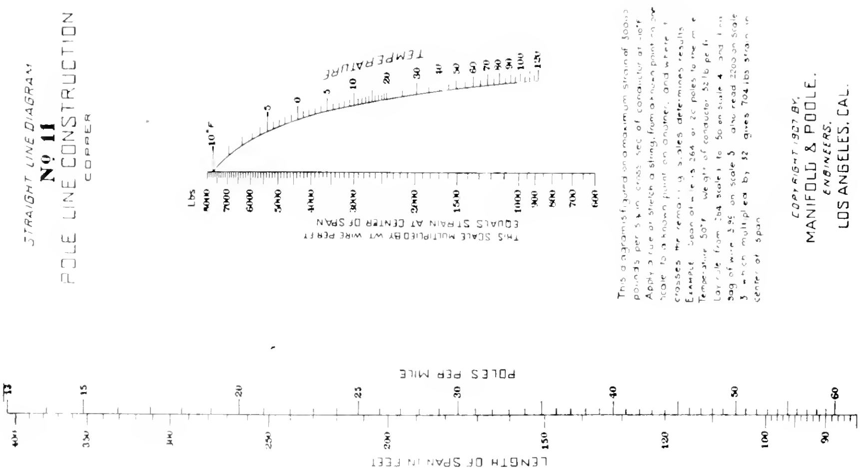
These engines are scarcely past the experimental stage in many points, although their economy of fuel is beyond question, and an absolute guaranty is necessary. The Germans are apparently looking more to getting the business than to immediate profits, and they realize the future of this type of plant under Mexican conditions.

There are good features in the American model as well as in some foreign designs, but an engine embodying all the best points of all the successful types remains to be produced. It is hoped that American manufacturers will make this combination, but they must be prompt, for foreign makers are much alive.

A gas-producer engine plant of 700 horsepower is contemplated for concentrating works for mining purposes, about 40 miles from the city of San Luis Potosi. The work is not yet definitely specified, but it is known that American engines will be preferred. [Name and address of the constructing engineer is on file in the Bureau of Manufactures, together with much other useful information concerning gas suction engines in San Luis Potosi.]

Man-power on the farm is estimated to cost about 11 cents per hour, animal horsepower about 8 cents per hour. Electrical power costs less and depreciates less.





POLE LINE CONSTRUCTION.

The accompanying diagrams are republished by permission from Manifold & Poole's "Straight Line Engineering Diagrams" (Technical Publishing Company, San Francisco), which contain similar solutions of many other problems in electrical and hydraulic engineering. These diagrams require no other explanation than the directions given to find the strain to which copper wire of known weight is subjected by a given span length and deflection at various temperatures. No. 11 covers spans from 85 to 400 ft. and No. 12 from 400 to 1100 ft.

STREET RAILWAY FRANCHISES NOT EXCLUSIVE.

An interesting case, covering street railroad franchises, has been decided this week by the United States Circuit Court of Appeals in the matter of the appeal of the Seattle Electric Company against the Seattle-Renton and Southern Railway Company.

According to the facts set forth in the decision, the defendant corporation operated a street railroad in Seattle. Rainier avenue being one of the principal streets of the road, under a franchise from the city. Under another franchise a competing road, the Seattle Electric Company, was granted the right to operate a railway over certain rights of way covered by the Seattle-Renton line, on and adjacent to Rainier avenue. The Seattle-Renton Company took the matter into the United States Circuit Court and applied for a restraining order to prevent the building of the competing line. It alleged that the operation of the new road would hamper, obstruct and render inefficient its road; that its earnings would be greatly reduced and the cost of operation greatly increased. It also was alleged that the ordinance granting the competing franchise was obtained by fraud.

Upon these representations the United States Circuit Court granted an interlocutory order restraining the new company from constructing its line and from this order the new company appealed.

The decision holds that the Seattle Electric Company had a right to occupy Rainier avenue, on the ground that a street car line franchise is not exclusive. The city, under its charter, has a right to construct and operate street car lines over its streets, and to grant others the privilege of constructing and operating railways over them. The ordinance is not in conflict with the Constitution of the United States, and the Seattle-Renton Company took its franchise and erected its lines of railway subject to the right of the city to grant to another a franchise, under which it would be authorized to operate a street railway over the streets occupied by the Seattle-Renton.

The decision says that the Circuit Court had no jurisdiction in the matter, and reverses the judgment of injunction, with instructions to dismiss the case.

PROPOSED ELECTRICAL LEGISLATION.

Three bills have been intruduced in the California Assembly by Mr. Kennedy of San Francisco regulating overhead and underground construction and creating the office of a State electrical inspector, which, if passed, would cause the needless expenditure of millions of dollars by the telephone and electric light and power companies.

No. 312 provides that all overhead conductors shall be spaced at least 13 inches from the center line of the pole, specifies that a distance of 4 feet must exist between wires carrying over 600 volts primary, and those carrying less than this voltage, all high tension crossarms to be painted a bright yellow, provides that guy wires and span wires be insulated, insists that vertical pole conductors be encased in wood at least 1½ inches thick, prohibits transformers on electric arc poles, provides insulated or grounded guard wires under circuits of 15,000 volts or more crossing above wires of lower voltage, and provides an additional safety bolt and clamp for suspending aerial cable of 75 No. 19 or 100 No. 22 B. & S. gauge or lower.

No. 313 provides that al electric subways and manholes in which men are to work must be constructed of stone, brick or concrete, equipped with sewer connection, must not be less than 4 x 4 x 5 ft. in size, that their openings must be at least 28 in. diameter or square, and not less than 3 ft. from any street car track.

No. 414 creates the office of a State electrical inspector who shall have had at least seven years' experience as a journeyman lineman. He is to be appointed for four years at an annual salary of $2500 and $50 monthly expense account and to have the power of appointing any number of deputies to see that the above provisions are properly enforced.

While these provisions are ostensibly intended to protect the lives of the electrical workers, they involve the practical reconstruction of almost all electric light and telephone pole lines in all the cities and towns of the State at an enormous expense, merely to provide work for men. To increase the present spacing of 8 in. to 13 in. means the ruination of the smaller telephone companies and the serious embarrassment of all others.

AMERICAN ELECTRIC RAILWAYS.

Ten billion passengers are carried in a year on the electric railways of this country. There are 35,000 miles of electric railway track (single), 75,000 cars, and the capitalization of companies is $4,000,000,000. Their annual income is $440,000,000. They have 250,000 salaried employees. The companies holding membership in the American Electric Railway Association —which is a professional and technical body of practical, operating railroad officials—own 26,425 miles of the above-mentioned track, 66,400 cars, and have a capitalization of $2,003,000,000. They carry 7,000,000,000 passengers yearly, almost five times the population of the earth! These gigantic figures and their significance were discussed at a banquet given to the American Electric Railway Association by the Electric Railway Manufacturers' Association, an affiliated body, in New York, the other evening at the conclusion of the former's midwinter meeting. In was shown, too, that within the next ten years the existing traffic will, in all probability, be doubled. Moreover, the steam roads which, like the Pennsylvania, New York Central and New York, New Haven and Hartford railroads, have already electrified divisions of their main lines, as well as the steam roads entering Chicago, will, a decade hence, have carried electrification over a mileage which at the present time would seem incredible. Steam roads having electrical divisions are admitted to membership in the Association. Only twenty-five years ago not a mile of electric track existed anywhere, not a dollar was invested in the business. Electric traction is the largest, and perhaps the most wonderful of the new industries.

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POWER AND GAS

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E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Exploiting Public Needs

"The public's needs should be served, not exploited," we said last week. Whereat several have objected that exploiting, or explaining in detail, is the only way in which these needs can be made known. Street railway patrons expect safe, rapid and convenient service in cross-seated cars, comfortably heated and ventilated. These public needs are frequently not obtained until they have been exploited or recounted at length, in the press or by other means of public expression. The Pacific Coast needs more people to exploit, or make completely available, its latent resources. So this journal has always exploited, or explained in detail, all of the power developments in this great country "from the Rockies to the Coast," once exploited, or explored, in quest of gold, but now capable of a more beneficent agricultural exploitation. In all of the above definitions exploitation carries a good sense.

But, just as most of the good things of this life become harmful in excess, so has this good old word recently fallen into disrepute and assumed an evil meaning which has already been given first place in the dictionary. If to satisfy the needs of street railway patrons it is necessary to sacrifice a valuable franchise which in turn becomes the basis for increased capitalization, and if the immediate necessities of the Pacific Coast are forced to pay a heavy toll of passenger and freight rates, then these needs are being utilized or employed in selfish schemes, they are brought out for the company's own advantage without regard to the rights of others, in short, they are being exploited.

It is unnecessary to here dwell upon the thousand and one ways in which a public service corporation can thus exploit the needs of its consumers. Whether they appear as bribery of public officials, interference in political nominations and elections, "fixing" of juries and judges, or in the greatest of all curses, over-capitalization, the practice is radically wrong and must be stopped. Closely allied to these actions contrary to the general public welfare is corporation advocacy of the policy of an "open town" in order that "owl" cars may prove profitable or that electric light and power may be used all night.

We well understand that the public service corporation is usually an unwilling party to these corruptions and is "held up" by predatory politicians who are the real cause of the evil. As long as the corporation is subject to local municipal control, so long will these abuses continue. The logical remedy is to vest the power of rate-regulation and franchise-granting in some State organization, such as a public service commission, whose members are technically qualified to handle the specialized problems involved and who are free from all political domination. Here the Governor, as the apointive official, is the responsible party.

PERSONALS.

C. F. Adams, president of the Portland Gas Company, is a San Francisco visitor.

G. McM. Ross, a mechanical engineer, was at San Francisco from Stockton this week.

T. C. Winck of the Tacoma Traction Company has been spending a few days at San Francisco.

Rudolph W. Van Norden, consulting engineer, has returned to San Francisco from Sacramento.

Clarence H. Howard, president of the Commonwealth Steel Company of St. Louis, is at San Francisco.

James H. Wise, of F. G. Baum & Co., has returned to his San Francisco office after a Northern California trip.

John Martin, president of the Coast Counties Light and Power Company of Santa Cruz, Cal., is spending several weeks in the East,

R. Leo Van der Naillen, superintendent of the Oro Water, Light & Power Company, was at San Francisco from Oroville during the past week.

W. S. Heger, California manager of the Allis-Chalmers Company, has returned to his San Francisco office after a trip to the factory at Milwaukee, Wis.

F. O. Sievers, connected with the sales department of the Pacific Coast branch of the Fort Wayne Electric Works, has been making a tour of Northern California.

Edward J. Nally, vice-president and general manager of the Postal Telegraph Cable Company, is at San Francisco on a general inspection tour of the Pacific Slope.

Sidney Sprout, who recently saved one of the islands in the Sacramento river from being flooded, has returned to his San Francisco office from Virginia City, Nevada.

Wynn Meredith and E. N. Sanderson of Sanderson & Porter, returned to San Francisco from Vancouver, B. C., this week, Mr. Sanderson continuing East after a brief stay.

A. H. Coates of the Colonial Electric Co. is attending the Chicago automobile show in the interest of his numerous Pacific Coast auto supply specialties. He expects to return to San Francisco about March 1, after visiting several Eastern cities.

Fred Poss, of the Holophane Company, and S. B. Gregory of the Arrow Electric Company, were recently presented with silver golf trophies, won at the Del Monte golf links during the Electrical Jobbers' meeting. R. D. Holabird made the presentation speech at the Palace Hotel, San Francisco.

F. H. Ensign has resigned as manager of the Pacific Gas and Electric Company of Phoenix, Ariz., after 5½ years' service. It is his intention to devote his time to personal interests and he has become financially interested in the New State Electric Supply and Fixture Company and the New State Auto Aerial Company and assumes the management of both concerns in addition to other personal interests in Phoenix and throughout the valley. Mr. Ensign retains his identification with the Pacific Gas and Electric Company as consulting engineer. Mr. R. G. Whitmarsh has been elected by the officials of the company to succeed Mr. Ensign as manager.

C. E. Thatcher, the new city manager of the Western Union Telegraph Company, at San Francisco, will have as his assistant C. W. Isaacs, who has been in the company's employ for twenty years. Mr. Thatcher recently arrived from Washington, D. C., where he occupied an important position at the head of the transportation rate section of the Treasury Department. He formerly had considerable telegraphic experience with the Burlington railroad system and elsewhere. He is also an International Exposition man, having represented the United States Government at both the Jamestown and the Seattle expositions in an important capacity.

Harry Curtis Rice, vice-president of the General Incandescent Lamp Co., Cleveland, Ohio, was married on Tuesday, February 7, 1911, to Miss Edna Tyler Kindelon, at Lynn, Massachusetts. The wedding was a quiet affair, attended only by the immediate families, Mr. and Mrs. Rice immediately thereafter taking the steamer from New York to Florida and Cuba where they will spend a few weeks. Mr. Rice's many friends on the Pacific Coast extend him their heartiest congratulations, especially as his bride is a California girl who thus adds another tie to those that already endear Harry Rice to the local electrical fraternity. Mr. and Mrs. Rice will be at home after April 15th, at Harlow Park, 1906 East 105th street, Cleveland, Ohio.

TRADE NOTES.

The Westinghouse Electric & Manufacturing Company has sold the Isthmian Canal Commission two 75 kw. motor-generator sets with a switchboard for the control of each. One of the motor-generator sets will be located in the substation near the site of the Gatun Locks and the other on the Pacific side near the Pedro Miguel Locks. The apparatus will be used in connection with the construction of the lock gates. The outfits will be installed at Gatun and Pedro Miguel and will operate on 25 cycle, 2300 volt energy transmitted from the power stations at Gatun and Miraflores. The motor-generators will convert this alternating current to direct current at 230 volts for use on the various small tools used in the gate construction.

NEW CATALOGUES.

The Banner Electric Company of Youngstown, Ohio, have issued a handsome souvenir description of the Allegheny County Soldiers' Memorial, a most novel and beautiful blending of illumination with architecture and decoration.

The Maxwell Gas Company of San Francisco have issued an interesting catalogue devoted largely to the production and purification of gas from the distillation of wood. This attractive publication was prepared by Mr. J. W. Swaren.

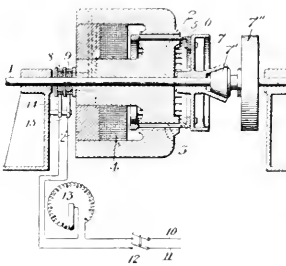
Theo. F. Dredge, representing the Richardson-Phenix Co., at San Francisco, is distributing their Bulletin No. 53, devoted to the Richardson Model "M" Mechanical Lubricator. This bulletin contains valuable data on friction in steam engines and how it may be minimized by proper lubrication.

The Kellogg Switchboard & Supply Co. has issued the second edition of Bulletin No. 32 on cord circuit practice for magneto switchboards. This bulletin is issued uniform with Bulletin No. 54 on party line equipment, the third edition of which is being rapidly exhausted. These two bulletins are written by a practical telephone man who understands the needs of the man behind the switchboard and on the right of way.

The Insulator Book from The Locke Insulator Mfg. Co., is being distributed by Pierson, Roeding & Co. This convenient loose-leaf catalogue of porcelain insulators, gives complete illustrated details of the various types of insulators, both suspension and pin, for all possible service. It furthermore includes valuable data pertaining to pole and tower line construction, wire, line protective devices, etc., as well as full information on tests of insulating material.

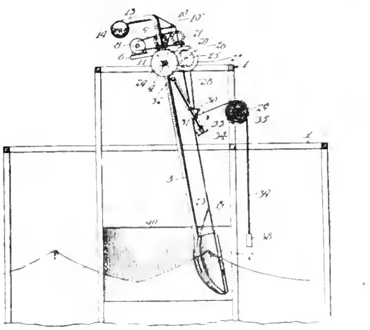
PATENTS

982,789. Electromagnetic Power-Transmitting Mechanism. Augustus Jesse Bowie, Jr., San Francisco, Cal. Power transmission mechanism comprising a positively driven primary element mounted on a rotatable main shaft, and a sec-



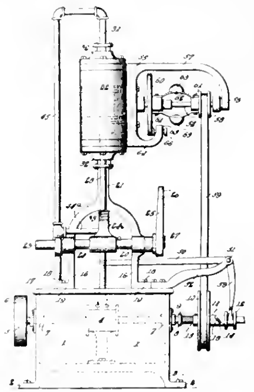
ondary element mounted on a rotatable counter-shaft, out of alinement with the main shaft and driven therefrom, said primary and secondary elements forming an electro-magnetic inductive system involving a magnet having an air gap, and an energizing coil for said magnet, and an electric conductor interposed in said air gap.

982,928. Wave-Motor. Telesphore J. Beaudette, Los Angeles, Cal. In a wave motor, the combination with a wave actuated rocking means, of gearing connected to said wave actuated means, a driven shaft, a connection from said gearing to said driven shaft, for increasing the speed of operation of the driven shaft at the latter part of the operating



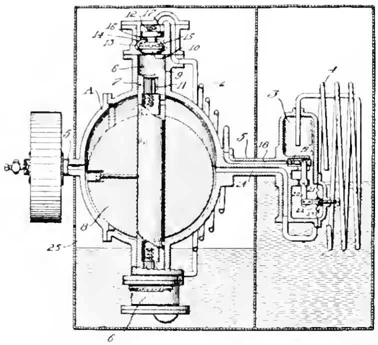
stroke, comprising a drum on the driven shaft, a drum connected to the gearing, a cable winding over said drums to wind off on one of the drums as it winds on to the other, a wheel engaging said cable to deflect it, a support for said wheel mounted to move with the rocking means, and means for adjusting the position of the said wheel on said support to vary the power of the motor.

983,216. Water-Governor. Arthur Dickerson, American Fork, Utah, assignor to Dickerson Automatic Governor Company. A hydraulic governor, comprising a tank, a pump therein, the shaft of the pump extending through the ends of the tank, means for connecting one of the ends with the prime mover, a longitudinally movable pulley on the other end, said pulley having a hub provided with a spiral slot, a pin on the shaft extending into the slot, a peripherally grooved disk rigid with the hub, a governor, a driving connection between the pulley and the governor for operating the same, a cylinder above the pump, a communication between the pump and the center of the cylinder, a plunger comprising a pair of spaced pistons in the cylinder, a hollow piston rod attached to each end of the plunger and extending through the ends of the cylinder, a pipe leading to the tank and having a branch at each end of the cylinder, a sliding connection between each branch and the adjacent end of the piston rod, said rod having an inlet opening in the space between the pistons and a plurality of exhaust openings



at each end of the plunger, a valve stem in the piston rod, a valve on each end of the stem, a double valve at the center of the stem, said valves being so spaced on the stem that when in normal position, the valves will be unseated, an elbow lever having one arm connected with the lower end of the valve stem and the other arm engaging the groove of the disk, a shaft provided near one end with an arm for connecting with the controlling mechanism of the prime mover, and having intermediate its ends a gear sector, and a rack bar on the piston rod meshing with the sector.

983,010. Rotary Compressor. Theodore R. Vinzent and Fred C. Bell, Alameda, Cal. A rotary compressor comprising a horizontally mounted casing having an ovoidal chamber, cylinders fixed to the casing and extending radially there-



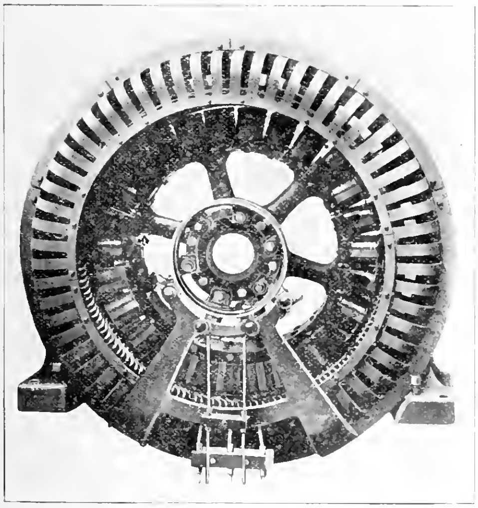
from, a double ended piston extending through said chamber and having its ends operating in opposed cylinders, inlet and outlet valve-controlled passages in the pistons and cylinders, and a weight fixed to the piston between its ends and inclosed by said chamber.

INDUSTRIAL

A.C. ENGINE TYPE GENERATORS.

A line of low speed, 60 cycle, engine type alternators embodying a number of new features of design has been recently placed on the market by the Westinghouse Electric & Manufacturing Company. The line covers capacities from 50 to 1100 k.v.a., 2-phase or 3-phase, and standard voltages of 240, 480, 600, 1200 and 2400 volts. A striking characteristic of the entire line, as shown by the machines already in operation, is the ability of the generators to successfully carry commercial loads of low power factor.

As the general construction and arrangement of parts of the revolving field generator is familiar to all, this description will be confined to the new features of this design, known as the type "E."



Collector End of 75 k.v.a. Type E Generator, 200 r.p.m.

The stator frames are of such design as to give great rigidity and plenty of freedom for the end connections of the armature winding. At the same time the construction is economical of material and affords excellent ventilation. The frame consists of a one-piece casting, except in sizes of such diameter that a split frame is a necessity for shipping reasons. In such cases the halves are bolted firmly together, making practically a solid frame. The frames of the smaller sizes are provided with slide rails on which the frame can be shifted to expose the rotor.

The armature core is built up of laminations of japanned steel of good magnetic characteristics. The laminations are dove-tailed in recesses in the frame. They are assembled under pressure and securely held by finger plates and end plates. Generous ventilating ducts are provided in the core to maintain uniform low temperature. The teeth are firmly supported at each end of the core by finger plates.

Repairs to the armature winding are very easily made because of the design of the winding. The armature slots are open and the coils are held in place by wedges. The coils are interchangeable and are completely formed and insulated before assembling in the core.

The end bells provided for the protection of the armature winding and attached to the end of the frame are of segments built up into circular form and so bolted together that they are light and open, yet rigid and indestructible.

The brush holder brackets, except in the larger sizes, are bolted to the armature frame, which makes each generator complete in itself. On the larger sizes, however, the brush holders are mounted on a pedestal which is to be bolted to the engine bed plate. At least two brushes are provided for each collector ring, which makes it possible to adjust any brush without opening the field circuit.

The rotor consists of a casting with laminated pole-pieces bolted on. The proportions of the casting are worked out with special reference to cooling strains, and the material used provides a homogeneous magnetic circuit. Edgewise wound strap is used for the field coils of all type "E" generators. This makes an ideal construction for field coils as every turn of winding is exposed to the air and heat is readily radiated and dissipated. The insulation between turns is of fire-proof quality.

The entire design of the type "E" generators is arranged for thorough circulation of the air.

The field poles of type "E" generators are so designed that a cage damper winding may be used when desired. Such a winding consists of a series of copper bars embedded in the pole faces, with the ends short-circuited like the squirrel cage winding of an induction motor. The winding serves as an effective damper to any fluctuation and thus tends to prevent "hunting." The cage damper winding is not essential to satisfactory operation, however, when modern steam engines are used as the prime mover. Where internal combustion engines are used the cage damper winding is advisable.

The collectors are of the spider type, consisting of two machined cast iron rings mounted on a cast iron bushing or hub, from which they are carefully insulated. The hub is belted to the rotor spider casting, so that the alignment is entirely independent of shaft adjustments.

Ample factor of safety is allowed throughout the mechanical design and the electrical design is such that overloads and low power factors do not interfere with satisfactory service.

RUGGED MOTORS.

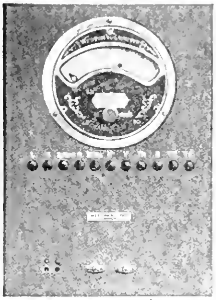
After the explosion and fire which recently destroyed the Los Angeles Times Building, two Bullock motors were removed from the basement where they were lying in 5 feet of water. The presses to which they were attached were completely destroyed and had no value except as scrap iron. The motors, however, were not badly damaged and were practically the only article of value saved from the ruins. In the adjustment of losses made by the Fire Underwriters' Association, 99 per cent of the total insurance was allowed, the 1 per cent saving being based almost entirely on the value of the motors. The life of the insulation of these was destroyed, but the commutators, brush holders, bearings and frames of the machines were in perfect condition. The motors attracted considerable attention and excited much comment because of the fact that they were the only pieces of machinery saved from the ruins. The larger motor is a 60 h.p., 500-volt, 400 r.p.m. machine, while the smaller is a 10 h.p., 450 r.p.m. machine. They are now being re-wound in the shops of the manufacturers, Allis-Chalmers Company, and will be used to drive new presses in the new building which is soon to be erected.

A TESTING CABINET FOR THE SMALL TELEPHONE SWITCHBOARD.

To meet the demand for an inexpensive testing outfit for small telephone exchanges, where a reliable means of testing is absolutely essential but where the outlay for an elaborate wire chief's equipment seems prohibitive, the Western Electric Company has placed on the market a new testing cabinet.

This cabinet, known as the No. 1107, can be used with any switchboard and will do practically the same work as the large and expensive wire chief's desks. It is made in two styles, one for use with magneto switchboards and the other with common battery switchboards. The cabinet is adapted to be fastened to the end of a regular switchboard, or elsewhere, as desired. The voltmeter is mounted on the front of a substantially made oak case, directly above the switching keys. The two terminals for connection to a Wheatstone bridge and the terminals for the grounding and testing cords are arranged at the bottom.

The apparatus consists of a testing circuit, an operator's circuit, a ringing circuit with keys and a grounding cord with flexible cord and plug. Both the testing circuit and grounding cord terminate on eight foot cords, and are equipped with No. 47 cord plugs. With these cords it is possible to reach across and get connection with the lines which terminate in the adjacent switchboard.



No. 1107, Testing Cabinet

A pair of binding posts placed in the rear of the cabinet provide a convenient means of connecting the telephone lines at the main distributing frame or terminal board, directly with the testing cabinet apparatus. By running a pair of wires from these binding posts to some convenient place near the main distributing frame and using a flexible cord provided with a test plug fitting the protectors, it is possible to test either the switchboard circuit or the outside line.

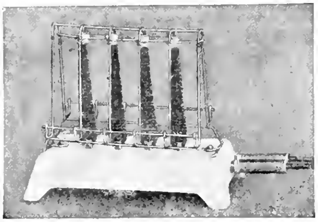
Some of the tests which can be made with this testing cabinet are grounds, opens, shorts and partial shorts, crosses, foreign battery, insulation, leaks, cross talk, loose connections, swinging troubles, earth potentials, poor grounds, open fuses, low resistance ringers across the line, receivers off, voltage of dry or storage cells, location of grounds in motor or generator fields of armature, resistances of receivers, drop coils, relays, etc.

IMPROVED VERTICAL RADIANT TOASTER.

The electric toaster is, perhaps, the most popular of the various electrical cooking devices now available. It is one of those remarkable articles, which so completely satisfies all the requirements of real convenience and utility, that it is rapidly attaining the character of a modern household necessity wherever electric current is available for domestic use.

When the General Electric Company brought out the first vertical type of toaster, its advantages were so apparent that it received quick recognition as ideal in its line. This appreciation was well merited because the new design enabled the making of two slices of toast simultaneously, greatly reducing the time and cost, and increasing the convenience of preparing the favorite breakfast dainty.

The vertical type of toaster not only represented a marked advance in the direction of increased utility, but served to establish the superior value of Calorite as a resistance material for producing intense radiant heat under the



Improved Vertical Radiant Toaster.

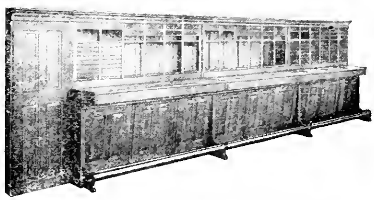
influence of an electric current. As in the case of tungsten, tantalum and other metals used as efficient light givers, the history of Calorite, the new metal used as an efficient heat giver, is too familiar to bear repetition. It is significant, however, that its production practically renders unnecessary any further development for the present of the electrical component of electric heating and cooking devices. On the other hand, modifications in the mechanical design and construction of any class of devices, for the purpose of increasing their utility, beauty or convenience, are always more or less possible, and electrical cooking devices are no exception to the rule.

The 1911 model of the G-E vertical radiant toaster embodies new features, commendable to prospective users of such devices. The inclined rack has been substituted for the perpendicular holder of the earlier design for increasing the convenience of the toaster. The slices of toast are thus rendered more accessible, and can be turned around more readily during the process of toasting.

The individual contact plugs adopted for the ornamental electric heating and cooking devices are applied to the new toaster. The plugs are incased in polished nickel cylinders, which add to the attractiveness of the toaster and places it in harmony with its companions on the buffet.

KELLOGG SAO PAULO INSTALLATION.

Among the many common battery exchange systems installed recently by the Kellogg Switchboard & Supply Company, the 11 section 10,000 line capacity exchange for Sao Paulo, Brazil, is of special interest on account of its size and importance. This contract was handled by Mr. J. C. Mur-



Sao Paulo Telephone Switchboard.

ray, sales engineer. This system is to be used first as a magneto multiple lamp signal switchboard, but is so designed that it may be changed to a common battery system without discarding any of the original apparatus. The present equipment is 4960 lines.

This handsome, massive quartered oak board, illustrated herewith from photograph taken just previous to packing,

will be equipped for 31 operators' positions, each to have 15 universal cords with ring back keys.

The Kellogg Company have furnished complete accessory apparatus, including intermediate distributing frame, terminal clips, for 4960 lines on answering and multiple side. The relay frame is for 5400 subscribers' lines.

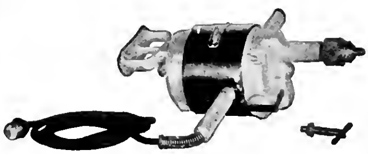
The Kellogg main distributing frame, is equipped with 4960 Kellogg arresters and terminal clips for 6250 outside lines. There is to be one-two position chief operator's desk and one-one position wire chief's desk.

The complete operating plant will be made up as follows: One set of 11 storage battery, 2 motor generator changing sets operated from 220 volts, 60 cycles, 3-phase alternating current, two ringing machines with howler attachment, one to operate from the battery and the other to operate from the primary battery circuit, one white Italian marble power switchboard.

The slight change in the wiring at the relay rack is all that is necessary to convert a magneto line to a common battery line. The cord circuits as furnished are of the universal type and will automatically adapt themselves to line conditions.

A NEW PORTABLE ELECTRIC BREAST DRILL.

A new line of "Western Electric" Hawthorn portable electric drills has just been placed on the market. These drills combine compactness and durability of construction with safe and reliable operation. They are made for use on 110 or 220 volt direct current, and 60 cycle, single phase, alternating current circuits, an Edison socket and cord being supplied so the drill can be operated from any standard lamp socket or screw base receptacle. The motor is incased in a dust-proof case and all electrical parts are well insulated and



Hawthorn Portable Electric Breast Drill

protected, insuring freedom from shocks. The frame is of black japan, with nickel-plated trimmings, and an aluminum breast-plate or spade handle can be had, as desired. Small oil chambers, so placed as to prevent leakage when the drill is being used, insure good lubrication for all moving parts.

The motor, weighing about twenty pounds, is supplied with two knurled side handles and the controlling switch is conveniently located within easy reach of the right hand grasping the handle, which allows the operator full control of drill. A Jacobs clutch, which takes drills up to and including ⅜ in. diameter, and the necessary tightening key are furnished.

NEW CATALOGUES.

Schureman Type Elevator Controllers, both direct and alternating current, are illustrated and described in a handsome booklet from the Cutler-Hammer Mfg. Co.

Bulletin No. 1117, describing central battery wall and desk sets, together with their accessories, for standard requirements, has just been issued by the Western Electric Company.

The Western Electric 1911 fan motor bulletin is now ready for distribution. This is listed in the series of publications of that company as bulletin No. 5352. It is contained within a stiff cover of bluish gray, with an attractive design.

TRADE NOTES.

The Westinghouse Electric & Manufacturing Company has just received an order for two 2000 k.v.a. water-wheel type generators and four 2000 k.v.a. oil-insulated water-cooled transformers for the main station of the Sao Paulo Tramway, Light & Power Company of Sao Paulo, Brazil.

The Pemberton Coal & Coke Company of Affinity, W. Va., has just placed an order with the Westinghouse Electric & Manufacturing Company for one 150 kw., 250-volt, 200 r.p.m., direct current engine type generator; one 150 k.v.a., 2500 volt, a.c. generator with exciter; a main station switchboard, and a 150 kw. substation motor generator set.

The Westinghouse Electric & Manufacturing Company has just placed upon the market a new trolley clamp that embodies several improvements. The swivel joint permits the boss to be screwed up tight to the stud; this keeps out moisture and prevents corrosion and wear of threads. The two side caps are absolute duplicates; the clamping pressure is therefore uniform. Having only two counter-sunk holes in each side, the clamp is stronger and the clamping pressure consequently more permanent. A few drops of solder in the swivel joint after the clamp is installed adapts it for feeding. The clamp can be installed with an ordinary screw-driver and a monkey-wrench, or with a special Type FB combined screw-driver and wrench especially designed for this service.

The Western Electric Company has just prepared for distribution an attractive 1911 wall calendar. The calendar, which has been finished in two colors, is of a pleasing design, and while the figures are large enough to be seen across the room, it is not too large for the office wall. The Western Electric Company's symbol, the familiar map of the United States within a circle, comprises the upper part of the calendar. The symbol represents the scope of activity of this company. A separate legend is provided for each of the twelve months, illustrating some phase of the company's manufacturing and selling program. Four cuts, showing the arc lamp, ventilating fan and power motor, and the Western Electric Inter-phone, as typifying the "essentials of modern business"—light, ventilation, power and communication—also are prominently featured.

Recent sales made by the General Electric Company include to the Sierra & San Francisco Power Co., 1 motor generator set consisting of 1 CVC-4-14 kw.-1800-140 volt shunt wound generator direct connected to 1 I-4-20 h.p.-1800-440 volt form K 60 cycle induction motor; to the Yuba Construction Company, dredge equipment for Kirtley Creek, 1 I-12-200 h.p. 600-M-440 volt motor, 1 I-12-25 h.p.-600-M-440 volt motor, 1 I-10-75 h.p.-720-K-440 volt motor, 1 I-12-35 h.p.-600-K-440 volt motor, 1 I-6-15 h.p.-1200-K-440 volt motor, 1 I12-50 h.p.-600-M-440 volt motor, 1 I10-35 h.p.-720-M-440 volt motor, 1 I-4-2 h.p.-1800-K-440 volt motor, 3 H-60-125 k.v.a.-4000/2000 volt-460/230 volt secondary transformers, 1 H-60-7½ k.v.a.-4000/2000-115/230 volt transformers, switches and circuit breakers, cable and wire, switchboard; dredge equipment for Feather River: 1 I-14-300 h.p.-514-K-440 volt motor, 1 I-12-35 h.p.-600-M-440 volt motor, 1 I-12-150 h.p.-600-K-440 volt motor, 1 I-12-75 h.p.-600-K-440 volt motor, 1 I-6-25 h.p.-1200-K-440 volt motor, 1 I-12-75 h.p.-600-M-440 volt motor, 1 I-10-60 h.p.-720-M-440 volt motor, 1 I-4-2 h.p.-1800-K-440 volt motor, 3 H-60-200 k.v.a.-4000/2000-460/230 volt transformers, 1 H-60-10 k.v.a.-4000/2000-230/115 volt transformers, switches and circuit breakers, cable and wire, switchboard; to the Pacific Portland Cement Company: 1 I-LM-2 T-6-A-2 6-ton mining type locomotive; to the Oakland & Antioch Railway: 1 motor generator set consisting of 1 MPC-4-300 kw.-720-1200 volt shunt wound railway generator direct connected to and mounted on common base with 1 ATI-10-345 kw.-720-11000 volt synchronous motor, 1 6 kw. 125 volt d.c. direct connected exciter.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL—The Searchlight Gas Company has been incorporated by F. C. Egan, M. L. Cramer and S. H. Ellis, with a capital stock of $100,000.

SAN FRANCISCO, CAL.—The Monterey & Pacific Grove Telephone Company has been incorporated by E. C. Gee, C. Bull, J. D. O'Connell, R. C. Smith and H. Haber, with a capital stock of $100,000.

FINANCIAL.

SNOHOMISH, WASH.—The water bond election held for the purpose of validating $110,000 worth of bonds to be sold for the purpose of a gravity water system from the Pilchuck river at a point in the forest reserve 16 miles from Snohomish and above all settlements, resulted in favor of the bonds.

LOS ANGELES, CAL.—The New York syndicate holding an option of $4,896,000 worth of Owens River water supply system bonds has paid for $816,000 worth of the bonds with accrued interest of $21,480. This transaction, together with the announced intention of the syndicate to take over the entire amount of bonds covered by its option, insures the completion of the Owens River aqueduct early in the summer of next year.

SANTA ANA, CAL.—The City Council passed an ordinance calling a special election to be held on February 14th for voters to submit a vote on the proposition of incurring an indebtedness by issuing and selling bonds in the sum of $20,000 for the construction of a municipal water system for this city. The bonds are to be issued 20 in number and of $1000 each, to bear 4½ per cent interest per annum, interest payable semi-annually, on September 1st and March 1st of each year after their issue until paid.

SAN FRANCISCO, CAL.—The first bonds of the $45,000,000 issue recently voted for the Hetch Hetchy water system were offered to the public last week, but found no takers. Some of the local bond houses had made no secret of their opposition to the issue. They had even frankly expressed their intention of discouraging the sale. It was stated that, as a matter of policy, they would remain aloof until the city "took care of Spring Valley." The offering was in the sum of $1,125,000 The money is needed to complete the purchase of the Ham Hall properties and to begin preliminary work at Lake Eleanor. The present is not regarded as an opportune moment for the sale of municipals in the United States. A recent New York issue found its buyers in Germany. M. Brock, of N. W. Halsey & Co., one of the concerns which has heretofore bid readily and heavily for San Francisco securities, stated that the reason why his company did not bid for the offering of water-supply bonds was that they were offered for future delivery, the greater part on June 1, and the smaller part on March 1, whereas when his company bought bonds it desired to secure them immediately upon the acceptance of its bid. He declined to say whether or not there were other objections to the purchase, that which he had named, he said, being deemed sufficient.

ILLUMINATION.

MANILA, P. I.—The franchise to build and operate a gas plant in the city of Manila passed the assembly recently afternoon. Thos. D. Aitken, representing a German syndicate, is the concessionaire.

CALEXICO, CAL.—The Farmers' & Merchants' Club has appointed a committee, consisting of J. B. Hoffman, J. F. Steintorf and H. J. Rick, to get exact figures on cost of establishing and operating an electric lighting plant in connection with the water plant.

CHICO, CAL.—Contracts have been let by the Pacific Gas & Electric Company for the erection of a gas storage tank of 100,000 cubic feet capacity in order that the capacity of the local plant may be increased. It is thought the work will be commenced within the next 60 days.

MARYSVILLE, CAL.—A deal has been consummated in this city whereby Henry Berg, Jr., and Nate Metz of this city become the owners of the Live Oak & Encinal Light & Power Company. The purchase price is said to have been $10,000. The new firm, will, it is said, extend the power lines over Sutter county.

OGDEN, UTAH.—The City Council has passed an ordinance granting to A. L. Brewer, J. S. Lewis, M. S. Proing, Joseph S. Cowcroft, J. N. Spargo, and A. T. Wright, a franchise to construct, maintain and operate an electric heating, lighting and power system within the limits of Ogden.

LOS ANGELES, CAL.—The Southern California Gas Company has made application to the Supervisors for a 50-year franchise covering all roads and highways of Los Angeles county, except those on which the Domestic Gas Company obtained a franchise for its Glendale system. The Supervisors ordered that the franchise be advertised.

PORTERVILLE, CAL.—All of the stock of the Home Gas Company is now owned in Porterville, the Los Angeles promoters having been bought by local capitalists. At the stockholders' meeting a new board of directors, including Porterville people only, was elected as follows: W. B. Phillips, president; F. H. Hess, secretary and manager, and L. J. Cranston, treasurer; other members of the board, Daniel Abbott and E. E. Graham. Plans have been made for the reconstruction of the plant. A high pressure line is to be put in to cover the entire city and the capacity doubled.

POCATELLO, IDAHO.—Through the voluntary sacrifice of property valued at $100,000, former Governor Brady furnished electric lights to Pocatello, which had been in darkness since the substation and transformer house of Brady's power company was destroyed by flood water Wednesday night. By dynamiting the power company's dam, Brady, who personally superintendened the work of redeeming Pocatello from darkness, was able to reach the company's transformers, buried deep below the surface of a flood in the Portneuf River and connect them again with the company's high tension transmission line from the plant at Ann Falls. Three hundred pounds of dynamite were used in blowing out the company's dam to reduce the level of the flood water around the wrecked transformer house. By the lifting of the railroad blockade and the resumption of the electric light system Pocatello is once again in normal condition.

PALO ALTO, CAL.—The Palo Alto Gas Company has offered to sell to the city of Palo Alto its plant, and a conference has been arranged between the representatives of the company and the officials of the city to arrange terms. The gas company has made the claim for some time that it was not making any money in Palo Alto and inasmuch as the city demands 2 per cent of the company's gross earnings and compelled it also to reduce its minimum charge to 50c per month after the company had raised the charge from 50c to $1, the gas officials think they are not being justly treated.

By the franchise the company is given the option or the purchase of the plant at the end of ten years. Three years remain until the franchise would call for such a conference as the gas company has now asked for. City Engineer Byxbee is compiling figures under the direction of the City Council, with a view of reducing the cost to the consumer of water and light, the plants for which are owned by the city.

TRANSMISSION.

SPOKANE, WASH.—The Washington Water Power Company has started preliminary work for installation of a power plant at Little Falls.

LEWISTON, IDAHO.—Engineers will soon make a preliminary inspection of the dam site at Kooskia preparatory to starting construction work for the Kooskia Land & Power Company.

SPOKANE, WASH.—The Pacific Power & Light Company is building a heavy copper wire power line from Priest Rapids to Beverly, Wahluke,, White Bluffs and Hanford, a distance of 35 miles.

GILMORE, IDAHO.—Plans are being prepared for the installation of a 600 h.p. power plant for furnishing power to the Gilmore mines, and also for furnishing this place with light and power.

VALE, ORE.—The Telluride Power Company will within the next two months connect this place with its big Malad River, Idaho, electric plant. The company is to build 150 miles of transmission line.

EUGENE, ORE.—The city has directed the city attorney to prepare an amendment providing for the issuance of $25,000 in bonds for the construction of a tungsten incandescent street lighting system.

SAN PEDRO, CAL.—During a thunder storm lightning struck the substation of the Southern California Edison Company on Terminal island, last week, and destroyed electrical transformers valued at $6000.

MEDFORD, ORE.—Harry C. Stoddard, superintendent of the Rogue River Electric Company, announces that work will start early this summer on the erection of a new power plant al Rogue River Falls, near Prospect.

PIERCE CITY, IDAHO.—The Pierce Power Company has completed plans for the installation of an electric power plant on its mining property one mile from this place. The plant will develop approximately 400 h.p., which will be used for operating dredges.

PIERCE CITY, IDAHO—The Sprague Company announces that the company will build a hydroelectric power plant about two miles above this place, with which to operate the mines of the Sprague Company, also the Idaho Placer Company and the Ozark quartz mine.

TURNER, ORE.—The Interior Warehouse Company, a branch of the Balfour, Guthrie Company, has secured a franchise from the council to install a plant for furnishing electric light to the town. Mayor Martin and the council are considering erecting lamp posts along the principal streets.

VANCOUVER, B. C.—The city electrician will soon ask the city for an appropriation of between $150,000 and $200,-000 to be expended on new equipment and addition to the present system during the year. Among the supplies to be asked for are: 300 additional arc lamps, 40 fire alarm boxes, 15 semaphore street signals, 28 miles of wiring, 30 police call boxes and a large number of lamps.

WASHINGTON, D. C.—Applications to the Forest Service for permits to use water-power sites within national forests now number 28. Since the promulgation of the new regulations 12 projects have been acted on. The permits pending are located in Washington, Oregon, Montana, Idaho, Colorado, Utah and Minnesota. It is expected these will be passed on within a short time. They are now in the hands of the district foresters, and if favorably reported will be turned over to the companies which will build the projects.

SACRAMENTO, CAL.—A bill has been introduced by Assemblyman Kennedy of San Francisco to regulate telephone, telegraph and electric transmission wires. The bill requires that wires must be placed on the pole so as to be thirteen inches from the pole on either side, thereby allowing twenty-six inches of space in which the electricians may work. Representatives of the power, light, telegraph and telephone companies have appeared before the committee and made vigorout opposition to the bill, saying that it would work a great hardship upon them and compel them practically to reconstruct all their lines throughout the State.

TRANSPORTATION.

VALLEJO, CAL.—The long projected Vallejo & Northern Electric Railroad from Sacramento to this city is an assured fact, and that line will be in actual operation soon.

MODESTO, CAL.—The South San Joaquin Improvement Company has been granted a franchise to operate a single and double track electric street car line in certain streets of this city.

PETALUMA, CAL.—Ranchers in the vicinity of Two Rock Valley have presented a petition to the Petaluma & Santa Rosa Railway Company, asking that company to extend their line from Live Oak through Two Rock Valley.

LOS ANGELES, CAL.—Paul Shoup, manager of the electric systems for the Los Angeles Electric Railway corporation, is preparing to build a tunnel through the hills from Hill street westerly. Plans have practically been accepted and rights of way secured.

GLENDALE, CAL.—An electric line will be built from the Brand Boulevard, at about Arden street, Glendale, to Burbank. Property owners of Burbank and Glendale will raise $40,000 and a double track line will be laid. A franchise has been asked for.

VALLEJO, CAL.—The Board of Trustees passed an ordinance permitting the San Francisco, Vallejo & Napa Railroad Company to change and substitute a single pole T-arm construction in place of the present span construction along Sonoma street from Illinois street to the city limits.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company and Anderson & Middleton have consolidated and will operate under franchises granted the latter. Announcement is made that the present power plant will be enlarged and interurban road construction on the harbor started.

PRESCOTT, ARIZ.—The management of the Prescott Gas & Electric Company has stated that in February the new electric line to Miller Valley will be started and in a few weeks all places would be connected. The new line will be run from a distributing station in the northwestern part of the city, taking in Home Acre tract, and will terminate at Mountain View cemetery.

MIDDLETON, CAL.—The high waters of Putah Creek hold freight and mail marooned in Middletown for the town of Lower Lake. The storms have stayed progress on the Santa Rosa & Clear Lake scenic railroad over St. Helena Mountain, but the work of surveying the north side of the mountain will be taken up as soon as there is a break in the storm, and it is expected to have the cars running into Middleton by the middle of the coming summer.

SANTA ROSA, CAL.—The Petaluma & Santa Rosa Railway Corporation has filed suit against Geo. C. Miller, Daniel Brown Estate Co., et al., to condemn a right of way for the extension of its line into the heart of Petaluma, and give the railroad an uptown depot site. This is the first step toward carrying out the proposed improvement of the company's property. The company will change its line in Petaluma city so as to give it an uptown depot for passenger service. The property is in the vicinity of Main and Washington streets. It is expected that now the first step has been taken it will not be long before a move is made toward extending the line to deep water on San Francisco Bay at Point Pedro, and straightening the road between Petaluma and Santa Rosa by running a line from the Washie House through the Cotati and up the Petaluma boulevard.

WATERWORKS.

MEDFORD, ORE. The City Council has passed ordinances providing for the laying of new water mains and sewers throughout the city.

VALLEJO, CAL. The water-pipe contract was awarded last week to the United States Pipe Company, which bid $24,587.02. For the 8-inch and 14-inch pipe this company bid $30.25 a ton.

SACRAMENTO, CAL.—The joint resolution protesting against the Federal Government giving the Truckee General Electric Company a contract to divert the waters of Lake Tahoe into Nevada, has been passed by the Assembly and the Senate, the Senate inserting a declaration of State rights.

SAN FRANCISCO, CAL.—In the Market Street Securities Company's suit to recover 5000 shares of stock of the Sierra Nevada Water & Power Company turned over to the National Surety Company of New York as security for a bond, Superior Judge Hunt has granted an injunction restraining the surety company from disposing of the stock pending the trial of the case.

LOS ANGELES, CAL.—President Ed. T. Youmans and Secretary F. D. Cornell of the El Sobrante Land Company, which has just purchased 43,000 acres of land near Riverside, are planning to develop water extensively on the tract. It is planned to construct a dam across the canyon which will create a reservoir covering 250 acres and which will be of an average depth of 15 feet.

ASTORIA, ORE. The Water Commission has awarded a contract to Palmberg & Matson for rebuilding 7½ miles of the wooden portion of the 18-inch main conduit leading from Bear Creek to the large reservoir, the contract price being $68,117.35. The pipe is to be built of redwood staves, and by the terms of the contract the work must be completed on or before September 1.

TACOMA, WASH.—Application has been made to the Board of County Commissioners for Pierce county, by the city of Tacoma, a municipal corporation, through its commissioner of water and light, for a franchise to construct and maintain within the easterly ten feet of the Mount Tacoma-Canyon road a flume of pipe for the purpose of conducting the water of the proposed Green River gravity water system of that city.

DOUGLAS, ARIZ. The City Council has awarded the contract for constructing a water system as follows: M. F. Diens, local contractor, received the following contracts for concrete sump, oil reservoir, well tunnels, furnishing and laying of pipe connection, valves and general work for $40,000. Chicago Bridge & Iron Works received the contract for the water tower for $11,950; Denver Rock Drill & Mfg. Co., pumping equipment, $8510; Simplex Venturi meter at $572; Davergn Machinery Co., machinery at $19,945.

TACOMA, WASH.—The council has passed an ordinance providing for the construction of 12-inch, 14-inch, 16-inch and 18-inch wooden water mains in local improvement district No. 562 in this city.

OAKLAND, CAL.—Officials of the Peoples Water Company are considering the proposition of raising the dam at Lake Chabot in order that many millions of gallons of water which are now going to waste, may be saved. The recent rains have filled the lake and the excess waters are now running through the waste gates. It is estimated that the amount of water which is now running away is equivalent to a two years' supply. The lake now contains 5,500,000,000 gallons of water. By raising the dam higher the capacity of the lake, which is the chief reservoir of the People's company, may be increased to 11,000,000,000 gallons. When the dam was originally built it was so constructed as to provide for an addition to its height should the necessity ever arise.

OAKLAND, CAL. The Peoples Water Company has filed with the finance committee of the City Council its report for the year 1910, upon which the water rate for the coming fiscal year will be fixed. The report gives in detail the amount paid by each individual ratepayer, the revenue derived from every source, an itemized account of expenditures made for supplying water, and amount of money expended in purchase, construction and maintenance of the property necessary to carrying on of business, since going into operation. The folowing is a summary for the Oakland division: Receipts—Water rates, $999,946.61; tapping, $28,981.15; turn on, $957; land rents, $32,263.89; total, $1,057,154.65. Expenses Supply, $18,699.48; distribution, $105,681.07; repairs, $19,011.41; general expenses, $149,588.48; renewals, $3844.48; administration, $8800; service construction, $11,619.22; total $317,143.67. To this last total add $84,855.39 for taxes, a grand total of $401,999.06. The balance, or net earnings is $655,155.59. Following is a list of investments of the larger amounts: Real estate, $10,920.39; Alvarado wells, $6422.95; street mains, $102,284.89; meters, $57,810.16; central reservoir, $198,667.87; general $9603.92; total, $414,925.73.

SAN FRANCISCO, CAL.—City Engineer Marsden Manson considers $37,310,000 a price which may reasonably be paid by the city for the Spring Valley properties and system as a whole, so stating in a formal report to the Board of Public Works, which that body passed on last week to the Supervisors for the benefit of the public utilities committee. With his estimates the city engineer couples the suggestion that no time be lost in resuming and carrying to an effective conclusion, if possible, the negotiations for the acquisition of the properties, and presents arguments that such action would be good business policy, both for the city and the company. He suggests that in purchasing these properties "the city can better afford to deal generously, or, from the standpoint of some, extravagantly with the company" to the end that city officials may "devote their time and energies to developing the city instead of annually discussing the problem of rates and prices for months, only to need in costly and prolonged litigation, for which the city ultimately pays the cost of both sides." The city engineer suggests two plans for meeting the expenditure necessary to carry out his scheme of acquisition, one being that a sufficient amount be taken from the proceeds of the $45,000,000 water-supply bond issue, already authorized. The other plan calls for the passage of a charter amendment which will make the present rule limiting bond issue, to 15 per cent of the total city assessment, apply only to non-productive utilities, in which case there will be no difficulty in authorizing special bond issues for productive utilities. Engineer Manson closes his report which was called for a month ago by the public utilities committee, by suggesting that representatives of all parties and organizations be called to consider his suggestions before any definite action should be taken.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVI — SAN FRANCISCO, FEBRUARY 18, 1911 — NUMBER 7

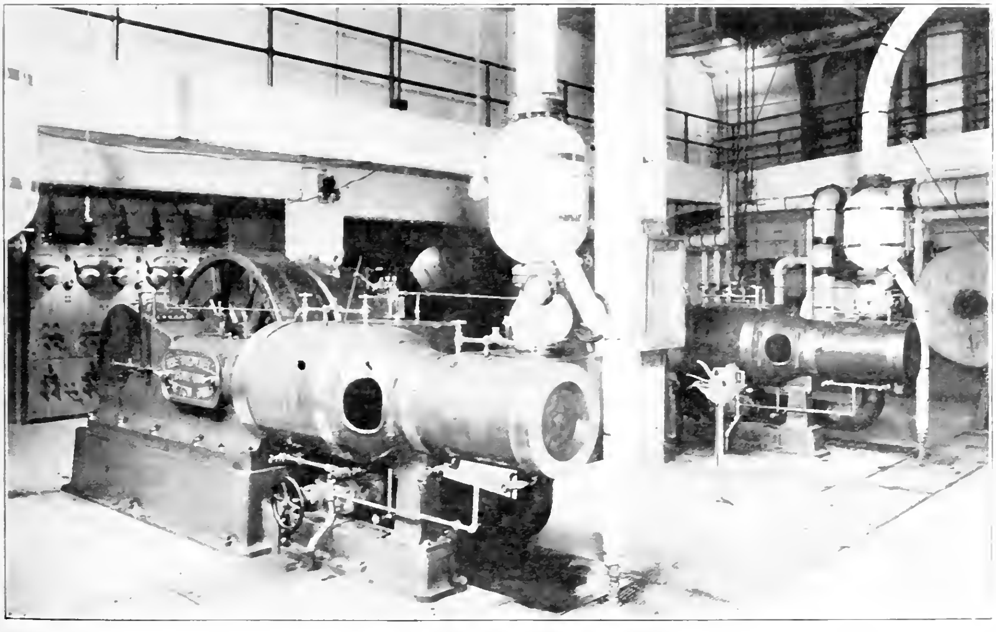
Y. M. C. A. POWER PLANT

BY B. H. BARBER

An interesting power plant has recently been installed in San Francisco's new Y. M. C. A. building, which for accessibility and general arrangement has received more than the usual attention from its designers.

The engine room is 61x58 ft. and 21 ft. high over the engines and boilers, a gallery running around two sides for the accommodation of visitors. A 5-ton chain tackle is hung from an overhead trolley which is carried directly over the main shafts of both engines and generators. The concrete walls and pillars are finished with white liquid stone paint, and as ample ventilation and natural lighting is provided, the usual heat and dark corners of a sub-basement engine room are noticeably absent.

The boiler equipment consists of three Franklin water tube boilers, each having 1046 sq. ft. of heating surface, and a commercial rating of 104 h.p. These boilers are arranged with an improved furnace for burning fuel oil, which is supplied from a 4500 gal. storage tank under the Leavenworth street sidewalk by a No. 3 Wilgus oil set. Wilgus burners are used, and evaporative tests have shown an average equivalent evaporation of 14.54 lb. of water from and at 212° per lb. of oil, for each boiler and while carrying an overload of 50 per cent.



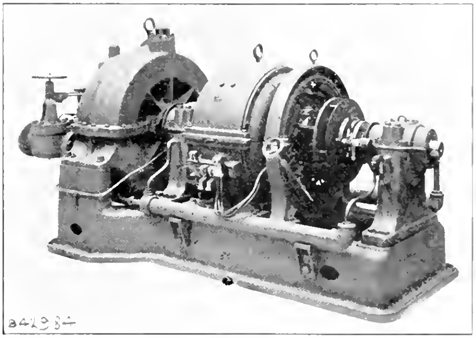
Switchboard and Engines in Y. M. C. A. Power Plant

Two Brownell 20th century [illegible] compound engines, direct connected to [illegible] Westinghouse 220 volt, three-wire generators and [illegible] Westinghouse 100 kw., 220 volt, three-wire turbine and generator supply the current for the lighting and power service of the building.

The engines are 10 in. and 17 [illegible] in. x [illegible] in. stroke and at 250 r.p.m. with 125 lb. pressure at the throttle with 1/3 cutoff develop about 155 [illegible] h.p. The governors on these engines are of the [illegible] inertia type

and extremely sensitive to sudden fluctuations of load.

Upward of 4000 Mazda lamps of from 25 to 100 watt capacity are used throughout the building, while the power load consists of three passenger elevators, one service elevator, one sidewalk elevator and five fan motors. Current is used at 220 volts for the elevators and fan motors, while equalizing transformers take care of the unbalanced lighting load at 110 volts. The elevator service is severe, often imposing swing loads of 90 per cent to 100 per cent of the normal being carried on the engines and as often as five times in a minute. The engines have been able to handle this variable load in a very satisfactory manner.



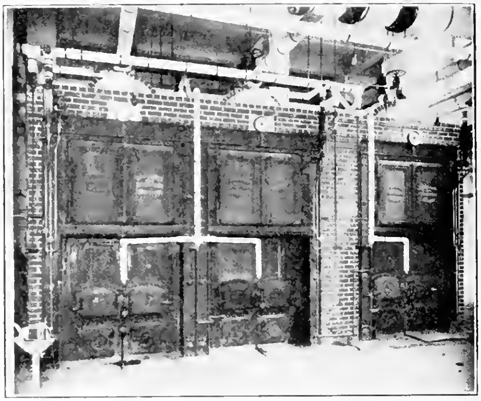
100 kw. Westinghouse Turbo Generator.

The switchboard is built of blue Vermont marble and is mounted with standard Westinghouse instruments and arranged with double throw switches so that all machines may be run in parallel on lighting and power service or each service can be supplied from separate units.

Break down service is also supplied, to be used in case of emergency, a specially constructed switch being used to throw over the d.c. service and which makes contact on one side before letting go on the other, which insures that the circuit breakers and potential switches on elevator motors and fan rheostats will not go out when changing over. This is important, as the elevator machines are all overhead and any momentary break in the current would necessitate resetting all potential switches. A separate voltmeter is supplied on the outside service and a plug connection is provided for cutting in the swinging voltmeter for comparison when changing over the load. Piping is all hung from the ceiling and covered with 85 per cent magnesia covering. Each boiler is connected through a 5 in. angle valve and pipe to an 8 in. main header; 5 in. long radius pipe bends with stop valves lead from the top of this header to each engine. Crane separators are used over each throttle, all draining to a common trap which discharges into the feed water heater.

A 4 in. auxiliary header extends across the tops of the boilers, and supplies the oil set, vacuum cleaning machine, two well pumps, two Spring Valley pumps, two vacuum return pumps, feed pumps and salt water circulating pumps. Steam is also supplied from this header to a 350 gal. direct water heater for the kitchen supply; through a reducing valve to the cooking kettles in the kitchen and to the laundry on the ninth floor. This auxiliary header is also connected to the main header through a 4 in. angle valve which is ordinarily kept closed. Steam for the oil burners is supplied by a separate 1¼ in. connection to each boiler so that the burners are not affected by the supply of steam to other places.

The exhaust and drain pipes are carried in a trench at the rear of the engines. An extra large vertical oil separator is provided to catch all entrained oil. From this separator the exhaust is carried to two large



Franklin Water Tube Boilers.

fresh water heaters and the salt water heater, then carried up as a riser through the building, to which all the radiator leads are connected. The back pressure valve is at the roof and is set to maintain 2 lb. pressure on the heating system. All condensation possible to recover is drawn back through the vacuum pumps and returned to the feed water heater.

A circulating pump passes the salt water from the swimming tank through a pair of Jewel filters and the salt water heater, returning it to the plunge at a temperature of 80 degrees. All water for flushing purposes, etc., is obtained from six wells under the building, while Spring Valley water is used for cooking, drinking and boilers, all except that used in the boilers being passed through Jewel filters before using.

Ventilation for the auditorium, lecture halls and class rooms is controlled by direct, indirect radiation, fresh air being drawn from a light well on the north side of the building and after passing over steam coils, delivered by motor driven fans in the engine room to the various points as required. Exhaust fans are also provided to insure a constant circulation throughout the system.

McDougall Bros. were the architects of the building, Mr. Harry Leavitt acting as their consulting engineer. Mangrum & Otter installed the heating and ventilation system and all piping in the plant, the Compressed Air Machinery Company being the contractors for the installation of the boilers, engines and generators.

THE GASIFICATION OF PETROLEUM.

BY E. N. PERCY.

The manufacture of gas from petroleum for illuminating purposes is mainly accomplished by spraying the oil either on to a white hot surface, into a very hot space surrounded by incandescent surfaces, or both. The factors entering into action under these conditions are the element of the specific heat of the gas and of the oil-brick or other heat reservoir, the element of time, and the element of temperature.

Eliminating Pintsch and other retort oil gas processes, and assuming fire brick heat storage, now in general use, we can assume that the specific heat factor is fairly constant under all gas making conditions.

While the composition of acceptable illuminating gas is somewhat complicated, and while there are many mixtures that are perfectly acceptable under the name of illuminating gas, it is probable that oil gas of this nature may be made within narrow limits of temperature, if so desired. Extremely high temperatures tend to resolve oil into ultimate hydrogen and carbon. Gas making, as practiced, is intermittent, and some engineers insist on high heats, making a gas high in hydrogen at first, and tailing out the run until enough fat gas is made at the end to bring up the candle power to the desired 20 or 22. Others use a more moderate heat, and produce a gas that is almost right all the way through, stopping the run before the gas becomes too rich and tarry.

The element of time has two sub-factors, one is the absolute time necessary for the oil vapor to be brought up to the cracking point, and the other is the time occupied by the vapors and gases in gaining an opportunity to become heated; this is explained by describing illuminating gas as a compound in which certain parts, like hydrogen, and methane are thoroughly heated, while other parts are less completely broken up, although passing through at the same time.

Every compound has a critical temperature. If it is formed above this point it will break up exothermically below it; if it is formed below this point it will break up endothermically above it. A complicated substance like oil contains compounds of many different critical points, hence no gas apparatus can ever even approach theory in action, but merely operate as a sort of an averaging contrivance. To illustrate this point, suppose oil and steam be sprayed into an incandescent chamber. The oil splits into hydrogen, carbon and other compounds. The steam splits into hydrogen and oxygen. Writers have frequently shown how theoretical temperatures may be calculated, and explained why we never reach them; but a little reasoning shows that regenerative furnaces of any type should greatly exceed these temperatures. They do, but not to the extent indicated by reasoning and figures. This has caused the writer to reason that the calorific value of substances decreases as the temperature rises. For instance, hydrogen and oxygen combine, giving off great heat, and their theoretical temperature is their critical temperature. Above this temperature, they will not combine, indeed, they are separated by heating above this point. Is it likely that this is a sudden change? Is it not likely that the calorific value of hydrogen gradually decreases as its temperature rises, until at critical temperature, it is incapable of combining with oxygen, and above this temperature its calorific value is even negative? On the other hand, take a substance like aluminum, incapable of oxidizing below a certain temperature, yet doing so easily above this temperature, and acting exothermically as an oxide compound, below this temperature.

Returning to the gas generator, the carbon has a specific heat many times that of hydrogen, also, is many times in excess, by weight, hence much cooler. The carbon has not had time to heat to the critical point, and at the moment of liberation, every atom is surrounded by films of highly heated nascent hydrogen, which oxidizes the available oxygen, the moment the temperature falls below the hydrogen critical point, but not with very great affinity nor great heat, because they are close to the critical temperature.

The net result is that when oil and steam are thus mixed, carbon monoxide will not be formed, as is well known to be the case.

Returning to the question of oil, the general characteristics of oils used for gas making are:

Gravity Beaume.	% C.	% H.	Calorific Value.	Heat Units Per Gal.
26	84%	13%	19,566 B.t.u.	146,530 B.t.u.
14	86%	11%	18,600 B.t.u.	150,660 B.t.u.

The heavy oil has 3 per cent more carbon, 30 per cent less hydrogen, and about 3 per cent more heat for the money paid out; but only 10 per cent or less of the oil is used for heating purposes in gas making, while over 90 per cent goes to make gas.

Now oil, in general, contains about 12 per cent of hydrogen. The following is a typical analysis of illuminating gas, made from oil only:

Benzol	0.90	Combustible	89.90
Illuminants	4.23	Noncombustible	10.10
Monoxide	1.23	Candle power	18.31
Methane	33.76	B.t.u.	633.5
Hydrogen	46.78		
Dioxide	1.00		
Oxygen	.50		
Nitrogen	8.60		
	100.00		

Calculation indicates that an ultimate analysis of such a gas results in about 25.8 per cent hydrogen, and 74.2 per cent carbon, the remainder consisting of miscellaneous matter.

The gas has twice as much hydrogen as the oil, and 7/8 as much carbon. A simple calculation shows that about 2 lb. of oil are required to make 1 lb. of gas, with 3/4 lg. lamp black over, amounting to 3/8 of the weight of the oil used, or 30 lb. of lamp black per thousand feet of gas, on a basis of 10 gallons per thousand. This agrees closely with practice. In addition to this, in practice, there is much tar formed. Tar represents dead loss, because it contains hydrogen, and this loss is, theoretically, unnecessary; practically, it cannot be avoided with a heavy oil, but a light oil forms almost no tar, when rightly used.

Therefore, in buying heavy oil, which contains 30 per cent less hydrogen, of which there is never enough, and 3 per cent more lamp black, of which there is always an excess, the gas man is buying a material 33 per cent less suited to his wants because it is 10 or 20 per cent cheaper. In addition, it clogs his generators,

requires heating, etc., and is very much more difficult to handle.

Where the lamp black is used in a water gas plant, a notable saving is accomplished, but it is an expensive process from a labor standpoint, and a light oil would accomplish a large part of the same work in the original generator set.

The carbon to hydrogen ratio in illuminating gas is approximately 1 to 3, by weight. In light oil, it is 1 to 6.5, and heavy oil, 1 to 8. In small gas plants, the waste lamp black is used to heat the boiler. The writer favors using it in some simple type of producer to heat the oil checkers, in fact, a modified water gas plant, using mostly oil, and just enough water gas to utilize lamp black. The boiler should be run on gas (in small plants only), as it would enable the plant to run more steadily, consequently, more economically. It is easier to control a gas fire under a boiler, and it starts without trouble in a cold furnace. The gas itself is made much more economically, since the lamp black heats the checker, and the set runs more continuously, and seldom cools down.

A moment's inspection of the hydrogen carbon ratio of any gas, even a monoxide water gas, shows that it is not possible to manufacture a satisfactory illuminating gas that will contain all of the carbon in oil; but if all the heating be done with carbon, and carbon only, and the same fuel be utilized for water gas, it can all be used, even in the largest plants; but it hardly seems necessary to separate the plants. Why not operate a modified water gas set so as to run principally on oil, as stated before?

Assuming that 3/8 of weight of oil goes to lamp black, and that 10 per cent of oil is used for heating purposes, we have a heat balance as follows:

1 lb. of oil....18,600 B.t.u.	3/8 lb. of lamp black ..	5,150 B.t.u.
	1/10 lb. of oil........	1,860 B.t.u.
	17.8 cu. ft. of gas......	11,290 B.t.u.
		18,600 B.t.u.

Assuming 8 lb. per gallon, we have 7.7 gallons as the amount of oil necessary to make one thousand feet of illuminating gas as above.

The amount of lamp black agrees closely with practice. The oil for heating varies from 5 per cent in large sets to 30 per cent in small sets. As is well known, 9, 10 and 11 gallons are actually used, and the question arises, Where is the waste? It cannot be the heating oil, or waste of heat, because that is included in the 10 per cent. It cannot be in lamp black, because there is nothing to combine with it; therefore, by simple elimination the losses are traced to hydrogen. As all free hydrogen is saved, it must be in the form of a compound, and is quickly found in the tar. Tar, while a complex and variable substance, is very rich in hydrogen. A quart, or a gallon of tar per thousand feet of gas does not appear to be much, but when mentioned in terms of oil, it frequently accounts for 10 per cent or more. The writer tested one small plant using heavy oil, and in about two weeks, while using 10,000 gallons of oil for gas making and a small steam boiler, it filled a wash box 36 by 72 in. three-quarters full of solid tar, which, no doubt, contained free carbon. Immediately afterwards, a light oil of 30 Beaume was started, and practically no tar made thereafter. There was apparently more lamp black, but this was because it was lighter and fluffier, but weighed less. The amount of oil per thousand feet of gas made dropped more than one gallon; but it must be borne in mind that the light oil must be handled properly, or no gain will result. It will be necessary to use more for heating purposes, not because it has less calorific value, but because there is less, in fact no carbon, left in the set to burn out. Light oil must not be put through too much brick work, and should be forced or drawn through the set quickly, for two reasons, first, that the gas may not be cooked too long, breaking up illuminants and destroying candle power, and secondly, that it should issue at as low a temperature as possible after being made, for economy's sake.

When the writer began oil gas making on this Coast, it was a new subject to him, and he approached it unbiased, and made several years' tests and observations in that spirit. After much thought and study, he is still unprepared to favor any apparatus or system, and refers to their peculiarities merely as his personal observation.

Numerous tests and records of tests of long machines of U type, H type or horizontal type show invariable economy in heating; that is, from 1/2 to 1 gallon per thousand feet of gas to heat the set. Short machines, such as used in small towns, or single barrel machines used anywhere show less economy in heating; that is to say, from 1 to 4 or 5 gallons per thousand feet of gas for heating set.

The long machines which make gas throughout the whole length show less economy on the gas making cycle, that is to say, they use 9 to 12 gallons for making gas.

The long machines which heat throughout, then make gas from both ends to the middle or both ends to some intermediate point are more economical on the gas making cycle, running 8 to 10 gallons.

The short machines, single barrel type, with short checker brick, not more than 4 to 6 ft., invariably are the most economical on the gas making cycle, running from 7 to 9 gallons per thousand feet.

The net result of all these tests is to show that to obtain the best results, a gas machine should be long for heating and short for gas making. This at once brings up a type that fires straight through, then makes gas from both ends to the middle, or both ends and middle to two take-offs.

It is almost impossible to calculate the amount of heat necessary, theoretically, to make gas; because, in the first place, it varies greatly, and in the second place, the calculation is too much involved. Some of the best records for heating run about 3 per cent of the total oil used, when running on an 8-gallon-per-thousand-feet basis. This is pretty good running. The issuing products of combustion were at a temperature of 2000 degrees F., roughly measured, indicating a furnace efficiency of about 50 per cent. This indicates that about 22,000 B.t.u. are required to make 1000 ft. of oil gas under commercial conditions. This figure must be divided by furnace efficiency, and any other unusual factor entering into the process.

The temperature is equally uncertain, and, probably variable, but several tests have established that at 2000 degrees F., a set will make satisfactory illuminating gas of 18 to 20 candle power, while if much

cooler than this, there is an increasing amount of tar and increasing candle power. As the temperature of combustion is from 3500 degrees F. upwards, and the brick are left at temperatures in excess of 3000 degrees after each heat; it is safe to assume a temperature range of 1000 degrees, from 3000 down to 2000 in all calculations of time, capacity, etc., as the results are pretty certain to exceed these figures.

The specific heat of brick is .2, and the weight 145 lb. per cubic foot, therefore each cubic foot is capable of storing 29,000 B.t.u. when heated 1000 degrees F.; but there is another factor that enters and is the most important of all. The factor of conductivity of brick is 1/83 that of copper; which means that for each degree difference of temperature, brick can only transmit 14.5 B.t.u. per hour per square foot of surface. With a thousand degree temperature range, amounting to an average difference of 500 degrees, each square foot of brick exposed to the heat can absorb only 161 B.t.u., and if the amount of oil to be burned during the heat is known, it is simple to calculate the amount of brick that should be exposed to it, and the length of the heat. Several checks by the writer show results corresponding closely with practice, where economy is obtained, but not otherwise.

There are several complex phenomena that enter in addition; they can be partially calculated, partially judged by horse sense, and help to explain some of the peculiarities known but not understood by every practical gas maker.

First—The heat gradually creeps to the interior of the brick, but will not become high, except after 20 or 24 hours' run. If a white hot brick be broken, one will be surprised at the coolness of the interior; still, after a day or two steady running, bricks get heated throughout, but the heat thus stored does little good, on account of the slow conductivity, and is usually radiated, after the day's work is done. Most of the heat for gas making is stored in the first quarter inch of the brick, and the skin of the brick does practically all of the work. To be sure they become heated through, and thoroughly carbonized, but instead of arguing, let the interested party remove a white hot checker brick after the first or second heat and break it quickly, and note the result. This is why a set with ample amount of brick work, heated slowly by a not too hot flame makes gas long and easily on the run, while a quick sharp heat only touches the skin, the run is short and strenuous, and as much heat strikes into the checker and lining as comes out to the gas, and the day's run may be over before returns are realized from the slowly heated brick.

Second—The radiation losses of an idle set are worth studying, since they are so easily measured. A small country set that runs about eight hours a day, making say 15,000 ft., will require 12 to 20 gallons to heat, or in other words, that represents the radiation. This opens up a field for thought in the lagging of gas sets, since their shell temperatures are relatively high, and radiation losses are large.

Third—There is the time element in heating. It would be easy, by tests, to establish a time basis, in seconds, that is necessary for oil to absorb the necessary amount of heat from brick, drop its carbon and gasify. This brings up another point of interest. From his experience with gas engines and oil gas generators for power purposes the writer is inclined to think that when oil strikes a white hot surface, it drops much carbon, and cracks to either pure hydrogen or very light hydrocarbons, while if it merely comes into a hot atmosphere, or receives its heat by radiation only, it drops less carbon, and forms much heavier and richer hydrocarbon gases. In other words, by having less checker brick, but more tube or lining, the oil would be just as thoroughly cracked, and gasified, but the gas would be of higher candle power, with less pure hydrogen, incidentally, suitable to mix with a monoxide, and carrying a larger percentage of carbon, which is another advantage.

Fourth—A correction which must always be made is for the latent heat of evaporation of the oil, amounting roughly to 220 B.t.u. per pound of oil.

Fifth—All of the reactions of oil gas making are endothermic. The net efficiency of oil gas apparatus varies from 25 to 60 per cent exclusive of lamp black and tar. By using the carbon or lamp black for heating the oil gas set, it would seem that an efficiency could be obtained comparing with coal gas producers making monoxide, and, in addition, a simple type of generator developed.

Sixth—The specific heat of illuminating gas is about .45, while that of hydrogen is 3.4. When an excess of hydrogen is formed, and as gas consists of half hydrogen, or more, the generator is cooled down quickly, until the illuminants are increased, thus, to a slight extent, an excess of hydrogen acts against itself. As every gas maker knows, a gas high in hydrogen takes more heat than a richer one.

Referring again to brick, it would seem as though cast iron could be used as a heat reservoir in gas sets, protected, of course, by a coating of brick, to prevent oxidation. The specific heat is .12, hence while it theoretically could not store as much heat, it would really store much more than brick, because of its high conductivity, resulting in quicker heating, longer runs, and greater economy.

The specific heat and conductivity of carbon and lamp black are about the same as brick, hence carbonized brick ought to be as good heat reservoirs as clean brick; as a matter of fact, the writer has never had it satisfactorily proven that well shaped carbonized brick should be thrown away, yet it is done right along.

Lamp black is made when the oil cracks into gas in a suspended condition from radiated heat.

Coke is made when the oil impinges directly on an incandescent body, or runs continually to one place and is evaporated by radiated heat to a solid residue.

Both of the above phenomena have been actually witnessed by the writer when oil was sprayed into a white hot reverbatory furnace, with the air shut off. After spongy coke, full of hydrocarbons is made, if the blast be turned on it, it will become incandescent, and burn slowly. In the course of time, it becomes very hard, of a bright silver color when cold, and very difficult to remove from the generator.

Lamp black, "sponge," asphaltum, etc., burn out easily with a strong blast, particularly if carefully done every time; but an accumulation of hard coke, once

started, stays incandescent, therefore cokes everything else that comes its way, and soon clogs the machine, because hard coke cannot be burned out in a puff like sponge coke, and the hydrocarbons usually known as "carbon in machine," and which vaporize as much as they burn, as is evidenced by the clouds of green smoke when the stack valve is lifted and blast on before, or even after, oil is on.

Under the conditions of heat, etc., favorable to many endothermic reactions, are formed carbides of iron, silicon, calcium, otherwise known as acetylene, sulphur, and copper, resulting in the weakening of metal structures, forming of explosive compounds and many other phenomena that appear mysterious to the worthy, practical man. The writer had the experience of throwing a few discarded brick into a vat of water, and seeing a perceptible amount of acetylene gas arise; not enough to light, but of unmistakable and characteristic odor.

Steam in the generator has many peculiarities. Assuming it to have been broken up into its elements, the oxygen will combine with white hot lamp black under the conditions previously set forth, but not with cold carbon. It is doubtful if heavy lodged coke is particularly active in any capacity, as the activity of carbon seems to depend upon the temperature and surface exposed, as in floating incandescent lamp black, which is really luminous flame.

Several types of machine taking off at the bottom, take in steam at the top, and oil half way down. They make the usual satisfactory illuminating gas. The writer has reversed the connections putting the oil in at the top, and steam in the middle. The oil gas was, obviously, made first, with attendant incandescent lamp black. The steam being broken up, went to monoxide in the usual way, and the percentage of monoxide was very much increased; whether desirable or not is another question, since it was purely an experiment.

Extensive experiments with the ordinary water gas set, as used for coke and coal in the East, show that 25 per cent of the gas is furnished by the oil. If all the gas were furnished by the oil, it would require about 8 gallons per 1000 ft., agreeing closely with our best practice. About one-seventh of the oil goes to tar. The operating temperatures are 1500 to 2000 degrees F. A great many very complete tests indicate that the latent heat of gasification of petroleum is about 400 B.t.u. per pound of oil. This is equivalent to about 13,000 B.t.u. per 1000 ft. of gas; but pure oil gas of the type used to carburet water gas consists almost entirely of hydrocarbons, and practically no hydrogen uncombined, and is, therefore, of high candle power. When making straight oil gas, it is cracked up to a higher point, liberating 40 to 45 per cent of free hydrogen, and cutting candle power down accordingly. This requires more heat, since the equations are all endothermic for the breaking down of hydrocarbons, without oxidation. The 13,000 B.t.u. will have to be raised. There have been no tests on oil gas machinery that have been made with sufficient care to establish this figure, since it can be established by elimination only, but putting this with our former reasoning, the amount of heat necessary is placed somewhere between 13,000 B.t.u. and 22,000 B.t.u. per 1000 ft. of gas. This corresponds to 1/8 to 1/16 of a gallon of oil per 1000 ft. for heating purposes. With a fair allowance for furnace efficiency, we are probably about as near to the theoretical figure as present available data allows us to approach; for purposes of calculation, it may be taken at 18,600, or the same as heavy oil. This makes a convenient figure, and there is such wide latitude in generator design, that the figure will serve all practical purposes, since it is equivalent to saying that 1 lb. of ordinary petroleum, working at 100 per cent furnace efficiency, can heat for the manufacture of 1000 ft. of gas. This figure would indicate that average generator efficiency on the heating cycle is about 30 per cent or less, which is probably about true.

Carbureted water gas is about the same as illuminating gas, except that the methane, monoxide and free hydrogen together occupy the volume occupied in ordinary illuminating gas by the methane and free hydrogen alone.

Either practical experience or calculation teaches us that in a water gas process, the carbon can furnish any amount of heat in proportion to amount used, and can gasify any amount of oil, and that there will always be an excess of carbon, if the oil gas be in the majority, yet with candle power held at 20. This means that money is saved by using carbon for heating and for monoxide. Also, it means that money is saved by adding a gas making material that contains no carbon, but hydrogen and oxygen with a capacity for taking up some of the extra carbon.

In other words, oil costs money, lamp black and water cost nothing (to the gas maker).

Therefore, why not use oil for just three things—the illuminants, the carbon and the methane.

Now use the carbon to heat checkers, and to make water gas, and pure water furnishes hydrogen and monoxide.

At first thought one would say that is merely water gas, but the idea is to increase the heats and oil, until oil gas and carbon are produced, to continue the heating. Of course the oil would have to furnish some hydrogen, in order to maintain carbon supply.

There is no special advantage in water gas unless there be some economy in its manufacture. The thermal economy is one possibility, and the use of water instead of oil another. It would seem as though the logical oil water gas plant would be a three-section checker heated by producer gas from a carbon set. Into one checker set put oil, and let it break to illuminants, carbon and some hydrogen. Into the second, let the steam be run, and split to hydrogen and oxygen. Let them combine with the lamp black in the third chamber, forming monoxide. As the action is exothermic, no checker is needed, and the combination takes place, with an evolution of heat, which increases the sensible heat of the gases, helps to crack up a few of the remaining heavy hydrocarbons, and is lost, unless the time comes that engineers use stack devices for saving such losses, which are not as large as they appear, because, in the first place, the specific heat of gases, referred to water, is very low, and the actual amount of sensible heat is small, because the total fuel

used for gas making is small compared to the fuel gasified.

If the products of combustion are analyzed, they should result about as follows:

CO_2, 13.8 to 14.5; CO, 2.5 or less; O, 2.5 or less; N, 81.6 about.

If the CO_2 is much less, or N much less, it indicates excess air. If the CO is high, it is a positive indication of too little air. If any hydrogen whatever is present in more than, say, 1 per cent, it is an indication either of faulty combustion, or very high stack temperature, or both. In considering it, one must bear in mind that critical temperatures and amount of air are both factors with hydrogen. When a generator is smoking a little, it is heating more economically than when the top is clear, because, first, if there is some smoke, there is not apt to be excess of air, while if the top is clear, there is apt to be great excess of air. When a generator is rather cool, and covered with tar, or heavy oil, and tarry carbon, nothing will keep it from smoking, because the heat is breaking down the hydrocarbons, yet is not hot enough to ignite them; but as the heat progresses, they will be observed to ignite. The heat is then said to have "come up." Frequently, when this is the case, and a little oil is turned on, enough to carry the flame up, with plenty of blast, the escaping hydrocarbons and free carbon will ignite, and burn brightly, if the oil be turned off again.

It is poor economy to have an excess of air for two reasons. In the first place, it is very easy to have 200 or 300 per cent more air than needed, and every 100 per cent going out of the stack at 2000 degrees temperature takes 20 per cent of the amount of heat that is really necessary, as a simple calculation will show; second, an excess of air, with strong draft, gives a sharp, quick heat, hard on the brick, and, bearing in mind their slow conductivity previously referred to, the heat is over more quickly, but less heat is stored, since it is all in the skin of the brick.

Steam is an obedient servant in placing a heat, and the writer has often marveled that gas makers are not more fully instructed regarding its use. Any generator tends to get hottest near the actual point of combustion, and excess air, with all its evils, or too little air, with its slow combustion, or other imperfect methods are used to "place" the heat. By the simple addition of a steam pipe to the blast, the writer has been able to draw the heat to any part of the generator. With any kind of blast or fire, after the nearer part of the generator is heated thoroughly, then the steam is turned in. Splitting it up absorbs heat from the overheated part, and it restores this when recombining in the tail end of the generator. Also, if put in with the fire, it lengthens out the combustion, partly by chemical action, and partly by physical, until it is perfectly possible to superheat the tail end of the generator, while the near end is not as hot.

The blue or Bunsen flame is believed by many to be the perfect combustion. This is a grave mistake. In the first place, the Bunsen burner of any kind, if burning a luminous gas with sufficient air to burn blue, has a great excess of air, with attendant losses as referred to. In the second place, it is well established that a luminous flame gives off more heat than any other for two reasons; having less air, it can burn at a higher temperature, and its luminous hydrocarbons, although absorbing heat while breaking up, return it in the form of radiant energy or heat, and radiate powerfully to any surrounding substance. This radiation is little understood, but is an important factor in a flame. The blue flame is clean, and keeps the bricks clean because of its oxidizing action with excess highly heated oxygen. Luminosity is caused by the breaking up illuminants, and the incandescence of their carbon in a finely divided state. While not as hot as the surrounding gases, the heat has more mass, or rather, the carbon has, more resisting power, more ability to transfer its heat by radiation and convection. The reason a Bunsen is not luminous is because the carbon never exists as carbon, but passes directly from the hydrogen atom to the oxygen atom which has already been carefully mixed and heated, with several extra ones handy, also heated.

To exemplify this, put a blue flame rose burner in the middle of a cold room. It has hardly any effect, yet the heat must go to the room. It goes in a narrow, highly heated path to the ceiling, and warms the ceiling only. Now put a sheet iron stove over it, and the radiating surface makes the whole room warm. Now remove the stove and put a pan of boiling water on. The room is again warmed by the steam, which has less temperature, but greater mass of heat, and greater ability to radiate. Now remove them all, and cut down the air supply until the flame burns bright yellow, yet without smoking. It will act very much as the stove did.

A yellow flame will heat a room more economically and can do it without radiating surface, which a blue flame cannot. Its action in the generator is sharp, because the inner cone, or reducing flame, is hot, while the remainder is cooled off heating the escaping excess air; and the writer will venture that excess air is found in any blue flame, wherever used.

Of course, this does not refer to those gases and substances that burn naturally with a blue flame.

As electricity is becoming cheap, and as it is demonstrated that it can be used to maintain carbon at a high temperature, the writer hopes to see a gas generator developed in which the temperature is maintained by electrical means, and carbureted water gas made by a continuous process; thus offering great inducements to electrical companies already in the business, cheapening gas plant attendance, and allowing holders to be much smaller. The writer has done some experimenting along this line. It is hoped that nothing in this article will be construed arbitrarily, as it is written in the spirit of personal observation and understanding only, not as irrefutable facts.

Leasing of water-power sites instead of a revocable permit has been approved by President Taft and is to be the subject of Congressional action in H. R. 32,-300 introduced by Mr. Parsons on February 2. Leases are proposed for 50 year periods and are irrevocable except for breach of conditions or of the regulations established which are not inconsistent with the lease, or for charging higher rates for power than may be established by the State. No lease is to be granted to or held by any trust.

PRECAUTIONS FOR HANDLING EXPLOSIVES

Miners' Circular No. 1, the first of a series to be written in plain, non-technical language for the benefit of the miner has just been issued by the Federal Bureau of Mines. It contains the names of the permissible explosives tested by the bureau at its Pittsburg station up to November 15, 1910, and gives precautions as to their use. Permissible explosives give a short and relatively cool flame that is less likely to ignite inflammable gas or coal dust than is the longer and hotter flame of dynamite or the longer and much more lasting flame of black powder. Because they can be used with greater safety, permissible explosives have taken the place of other explosives in many coal mines in the United States during the last two years and their use is increasing rapidly.

To reduce the risks in storing, thawing and handling explosives at coal mines, the following precautions are urged by the Bureau of Mines:

Don't store detonators with explosives.

Don't open packages of explosives in a magazine.

Don't open packages of explosives with a nail puller, pick or chisel.

Don't store explosives in a hot or damp place.

Don't store explosives containing nitro-glycerine so that the cartridges stand on end.

Don't repair a magazine until all explosives are removed from it.

Don't use permissible explosives or other explosives that are frozen or partly frozen.

Don't thaw frozen explosives before an open fire, in a stove, near a boiler, near steam pipes, or by placing cartridges in hot water.

Don't put hot water or steam pipes in a magazine for thawing purposes.

Don't carry detonators and explosives in the same package.

Don't handle detonators or explosives near an open flame.

Don't expose detonators or explosives to the sun for any length of time.

Don't open a package of explosive until ready to use the explosive, then use it promptly.

Don't handle explosives carelessly.

Don't use more than 1½ pounds of any permissible explosive for one shot in a coal mine.

Don't use a detonator (blasting cap) or electric detonator of less strength than No. 6.

Don't crimp a detonator (blasting cap) around a fuse with the teeth.

Don't economize by using a short length of fuse.

Don't use a metal tamping rod. A copper tipped rod is not to be recommended. Wooden rods are safer.

Don't use two kinds of explosives in the same drill hole.

Don't return to the face until at least 5 minutes after a shot has been fired.

Don't breathe the gases from the shot.

Don't return to the face after a misfire for at least one-half hour.

Don't attempt to draw the charge in case of a misfire.

Don't leave any detonators or explosives in a mine over night.

Don't charge or load any hole which has not been properly placed or has been drilled "on the solid."

Don't light the fuse of dependent shots at the time the first shot is lighted.

Don't expect to get satisfactory results with a permissible explosive or any explosive when a miner uses it for the first time.

Don't think the use of permissible explosives can take the place of other safety precautions in mines and thus neglect those precautions.

WOOD PRESERVING WITH ASPHALT OILS.

In a paper before the Wood Preservers' Association's meeting on January 19, 1911, Mr. Frank W. Cherrington describes experiments made and results obtained in the treatment of wood with asphaltic oils for the purpose of preserving it. In 1885 a committee on wood preserving of the American Railway Engineering and Maintenance of Way Association reported that crude petroleum would prove a preservative so long as it continued to saturate the wood by exclusion of water, but that the evaporation of the volatile oils rendered it useless for this purpose. Mr. Cherrington states that this report was based upon experiments with eastern paraffine oils, which are not stable in their composition. In 1901 the Santa Fe Railroad injected California asphaltic crude oil into pine ties and "laid them in a section of track in Southern Texas, where the climatic condition is one of the most severe for ties to be found in North America. A maximum quantity of oil was forced into these pine ties, the absorption per tie being, of course, dependent upon the amount of heart and sap wood in each tie." Oils from other sections of the country than California or Mexico were reported by the author to be too volatile and highly inflammable for this purpose in their natural state, but they can be refined to a desirable consistency.

Other experiments made on cross-ties were described. It was concluded from these that fairly good penetration could be secured in the various oaks, beech, gum, etc., when injecting all the preservative that the ties would absorb, this maximum amount being found to be about seven pounds per cubic foot. Short leaf pine ties were found to readily absorb straight asphaltic oil in larger quantities and with thorough penetration.

Other experiments were made with mixtures of 25 per cent of creosote and 75 per cent of asphaltic oil, and these appeared to demonstrate that the two substances remained mixed while penetrating the wood, and that a very satisfactory penetration was secured by the mixture.

"It is readily admitted that the only value of asphaltic oil obtained from the central United States as a wood preservative would be by the injection of a maximum quantity of oil into the wood." It is stated that in the test of ties so treated by the Santa Fe Railroad, nine years' test has indicated that where maximum saturation had been obtained the ties had been well preserved during this time. Nothing is stated by the author to indicate that any actual test has ever been made of the use of this material as a preservative for wood paving blocks, but we believe it is the intention of the asphalt companies to demonstrate its value for this purpose.

HOME TELEPHONE BANQUET.

In celebration of San Francisco's success in gaining the Panama-Pacific Exposition, employes of the Home Telephone Company of San Francisco recently held a big banquet at which 200 guests were present.

Many speeches were made, all of a congratulatory nature, and promising the most enthusiastic support in making the affair the biggest one of its kind ever held. The toastmaster of the evening was N. J. Prendegast, who sounded the keynote in a felicitous address. Among the other speakers of the evening were Dr. H. L. Hall, manager of the Oakland branch of the company; P. W. Alexander, A. McFarlane, S. Baer, John Wicks and William Henderson.

Home Telephone Banquet.

TUNGSTEN, TITANIUM, AND TANTALUM.

Although the figures from all the countries producing large quantities of tungsten are not yet available, enough are at hand to sho. that the world's production for 1909 was larger than in 1908, and was possibly equal to that of 1907. The estimated output for 1909 was 5289 short tons of concentrates containing 60 per cent of tungsten trioxide, compared with 3808 tons in 1908 and 6062 tons in 1907. In very few of the returns, however, is the percentage indicated, and this is necessary in comparing figures. It is probable that most of the exported ore is richer than 60 per cent in tungsten trioxide, and that the figures are therefore low. The principal sources of the 1909 productions were: United States, 1619 tons; Argentina, 900 tons; Australia, 1200 tons; Bolivia, 168 tons; Germany, 106 tons; Portugal, 609 tons; and the United Kingdom, 421 tons. The value of the tungsten ore produced in the United States during 1909 was $614,370, compared with $229,-955 in 1908 and $890,048 in 1907. With the recovery of the American steel trade during 1909 prices rose above those of 1908 and ranged from $5 to $9 per unit for tungsten ores, the average price being $6 to $6.50 per unit.

So far as known, the rutile (titanium oxide) deposits at Roseland, Va., are the largest in the world. The use of titanium in making steel rails increased considerably during 1909, and an American railroad which has given rails treated with ferrotitanium a long trial reports that they are proving entirely satisfactory. The use of titanium in arc-light electrodes is also growing. Of these, there are two principal types, one of which is an electrode made of finely ground titanium carbide, the other is composed of magnetite, chromium oxide, and rutile.

No production of molybdenum or uranium minerals and only a small output of tantalum mineral are known to have been made in the United States during 1909. The use of molybdenum in steel has not increased much. Tantalum incandescent electric lamps have such strong competition in tungsten lamps that the demand for tantalum minerals seems rather to have decreased than grown. The tantalum used in this country in 1909 was imported from Germany.

INDUSTRIAL POWER DATA.

The following table and curves are preliminary to a discussion on Industrial Power to be held at the February 24th meeting of the San Francisco Section of the American Institute of Electrical Engineers:

Motor Driven Machine Tools.

Motor driven machine tools, installed by Paul R. Shipley. Motors are all direct current, 220 volts. Motor ratings from name plates.

Tool.	Type.	Motor. H.P.	Amp.	R.P.M.
90 in. driving wheel lathe	Shunt	10	150	495- 950
90 in. driving wheel lathe, head	Comp.	½	28	950
72 in. driving wheel lathe	Interpole	10	42.5	400-1600
52 in. lathe	Interpole	7½	31.5	400-1600
36 in. lathe	Interpole	5	21.5	400-1600
30 in. lathe	Interpole	5	21.5	400-1600
18 in. brass lathe	Interpole	3¼	13.25	400-1600
Turret lathe	Shunt	3½	11.2	975
72 in. vertical boring mill	Interpole	7.2	31.2	400-1600
72 in. horizontal boring mill	Interpole	5	21.2	400-1600
51 in. vertical boring mill	Interpole	5	21.2	400-1600
78 in. radial drill	Shunt	5	19.2	1300-2000
48 in. planer	Comp.	15½	59.2	965
24 in. double head shaper	Comp.	6.5	25	870-1750
20 in. slotter	Interpole	10	42.2	400-1600
16 in. slotter	Interpole	5	21.2	400-1600
90 in quartering machine	Shunt	3	11.2	1050-2000
90 in. wheel press	Comp.	10	39	780
60 in. punch and shears	Comp.	11.2	13	1125
36 in. punch and shears	Comp.	10	39	780
Horizontal punch and binder	Comp.	7½	28.5	975
Car wheel press	Comp.	10	39	780
D. H. axle lathe	Shunt	12	46	500-1000
Car wheel boring mill	Shunt	7	26.5	590-1180
Car wheel boring mill crane	Shunt	¾	3	700
60 in. x 20 ft. flue rattler	Comp.	25	90	725
42 in. planer	Shunt	15	56.5	875
42 in. planer head	Comp.	2	7.5	1200
Double head bolt threader	Interpole	5	21.2	400-1600
No. 9 Sturtevant fan	Comp.	17	59.5	1700
Bolt header	Comp.	13	49.5	875
Trip hammer	Comp.	10	39	780
Coach wheel lathe	Shunt	15	57.5	935
Iron bed wood planer	Comp.	10	38	935
Wood bed planer	Comp.	15.5	59	965
Triple valve grinder	Shunt	2	7.2	1100
70 ft. transfer table	Series	25	100	450
70 ft. turntable	Series	7½	30	750
50 ton coal hoist	Comp	75	285	615-1120
Coach wheel lathe	Interpole	23	95	200- 600
Group drive—				
2 30 in. planers	Comp.	15	57	580
6 small lathes				
1 16 in. slotter				
1 60. in. radial drill press				
2 18 in. lathes				
1 36 in. emery wheel				
1 18 in. single head shaper	Comp	10	39	760
3 turret lathes				
1 18 in. lathe				
1 small lathe				
1 milling machine				
1 36 in. emery wheel				
1 24 in. cut-off saw	Comp.	23	85	750
1 band saw				
1 mortising and food drilling machine.				
1 18 in. joiner				
1 rip saw				
1 bolt cutter				
2 small drill presses				
1 pipe cutting machine				
1 24 in emery wheel				
1 18 in grindstone				
1 18 in. cut-off saw	Comp.	23	85	750
2 rip saws				
1 mortising machine				
1 sticker				
1 wood shaper				
1 buffeting machine				
1 saw grinder				
1 grindstone				

100-Ton Cran—	H.P.	R.P.M.
3 2[illegible]0 amp series motors	55	50-500
1 72 amp. series motor	18	50-500
2 30 amp. series motors	7½	50-500

30-Ton Crane—	H.P.	R.P.M.
3 100 amp series motors	25	575
[illegible] 13 amp. series motors	3.25	825

7½-Ton Crane—	H.P.	R.P.M.
1 30 amp series motor	7½	750
1 44 amp series motor	11	700
1 8 amp series motor	2	900

Telephone Exchange Motors.

Curves, Fig. 1 and 2, form part of the standard specifications for motors used in the exchanges of the Pacific Telephone and Telegraph Company. The power factor and efficiency are in every case the minimum permissable for the particular horsepower and load specified.

Submitted by C. W. Burkett, Chief Engineer, P. T. & T. Co.

Test of Gold Dredger.

Figs. 3 and 4, submitted by Mr. I. E. Ettrop of the Marysville Dredging Company.

Motor Driven Geared Lathe.

Test of an induction motor direct connected to lathe through a series of gears. Cuts of different depths and feeds were taken at different surface speeds on a bar of soft steel. The tool was Bethlehem Special High Speed steel and Taylor pattern

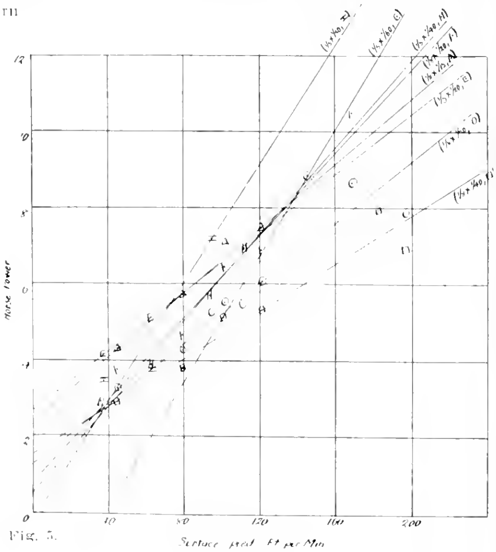


Fig. 5.

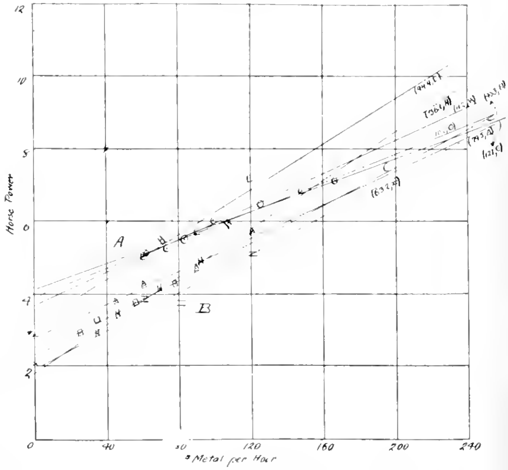


Fig. 6.

Each line is marked with its surface speed and the symbol determining that line

Motor Data—Built by Westinghouse Electric & Mfg. Co.; type CCL constant speed induction motor; 5 h.p., 200 volts, 12.3 amp. per terminal, 2-phase, 60 cycles, 1700 r.p.m. at full speed.

Lathe Data—Manufactured by Lodge & Shipley Machine Tool Co., Cincinnati, Ohio; style 18 in. patent head.

Figs. 5 and 6, submitted by H. H. Buell.

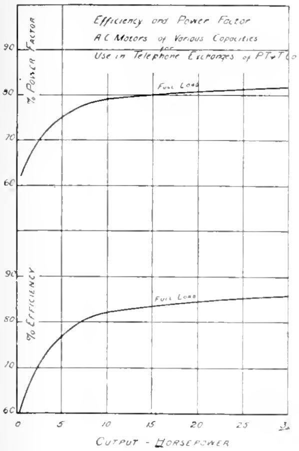


Fig. 1.

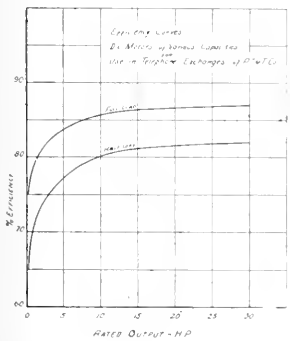


Fig. 2.

A.C. Motor Driven Centrifugal Pump.

An induction motor, two-phase squirrel-cage type was belted to a centrifugal pump. The pump discharged into a weir used to measure the quantity of water pumped. A Venturi meter was used to check this. The head, against which the pump was working, was varied by means of a valve; the first with the valve closed and maximum head, the second with the valve open and minimum head and the remaining three at points between the two.

The weir formula was $Q = 2.65 H^{5/2}$; weir zero was .150; the barometer was 29.898; temperature of water, 60° F.

Apparatus Motor—General Electric Company induction motor; type 10-6-10A-1200; form K; h.p., 10; cycles, 60; speed, 1200; amperes, 23; volts, 200.

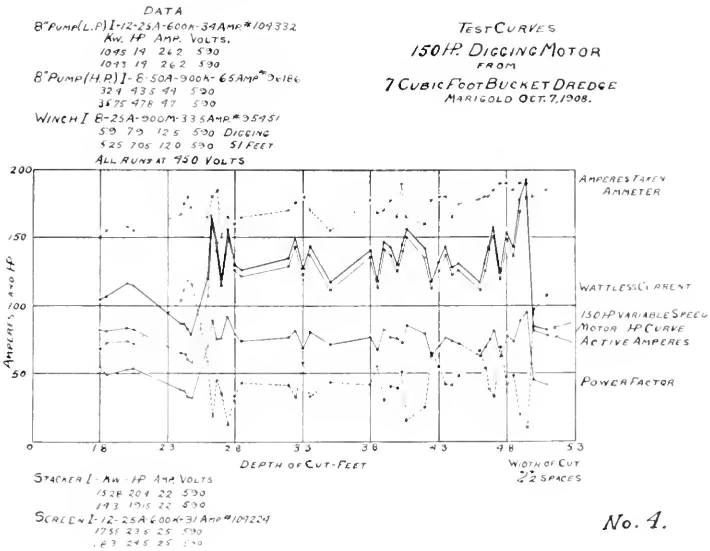


Fig. 4.

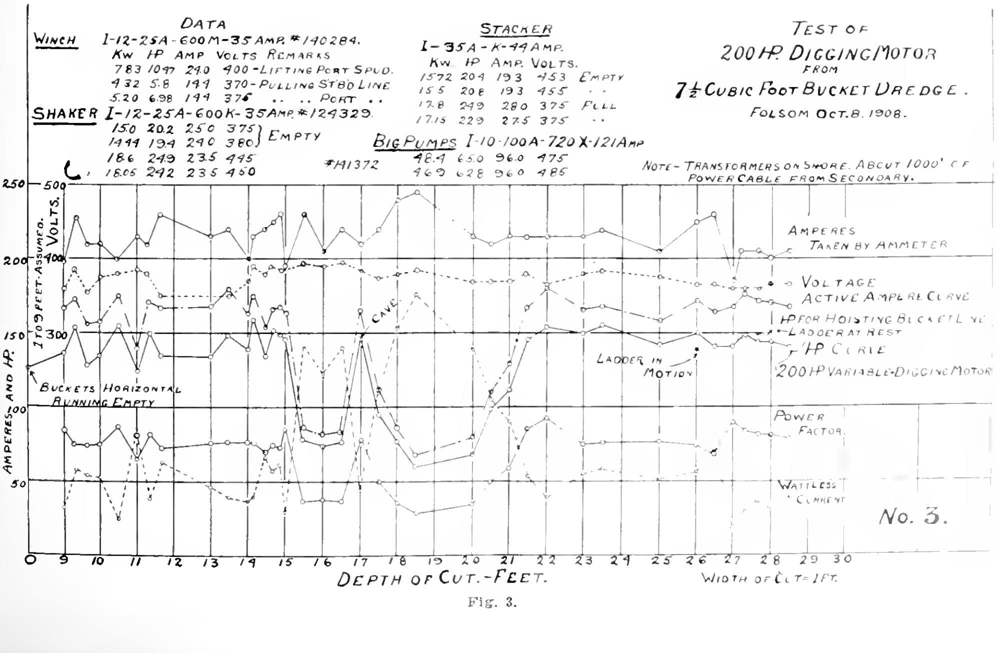


Fig. 3.

Pump.—Centrifugal type; diameter of runner, 7⅞ in.; diameter of discharge, 2 in.; diameter of suction, 2½ in.

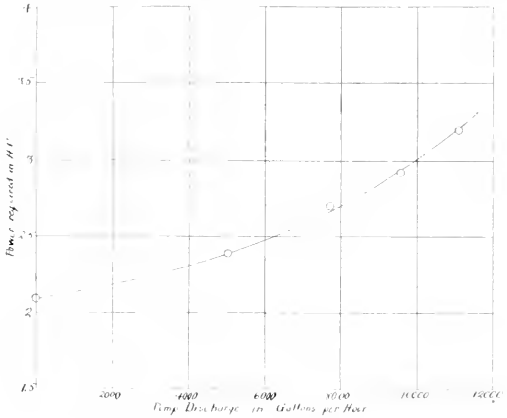


Fig. 7. 7⅞ in. Centrifugal Pump, 2 in. Discharge Diameter, 2½ in. Suction Diameter, 1700 r.p.m.

Combined Results—See Fig. 7.

Run.	gal. per hr. Pump dis.	Head.	H. P. Total	Pt.	in. of Hg. Suction
I	0	25	2.03	34.5	0
II	11,100	9	3.19	41.0	12.6
III	9,550	13	2.92	40.0	10
IV	7,700	17	2.70	38.2	6.5
V	5,000	21	2.39	36.1	3.5

Speed approximately constant at about 1700 r.p.m.
Submitted by H. H. Buell.

Test of 18 in. Reed Lathe.

This lathe is driven by a 2 h.p. direct current, shunt motor. The motor operates normally on 230 volts. The speed is controlled by varying the resistance in the field circuit. The motor was geared to the lathe spindle.

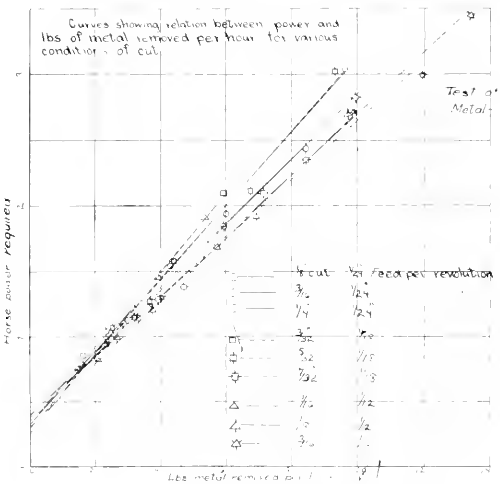


Fig. 8. Test of 18 in. Read Lathe Cutting Gray Cast Iron.

The piece of metal on which the test was made was a bar of gray cast iron. The head end was held in a three jaw universal chuck. The tool used was made of Bethlehem high speed steel, and was a Taylor pattern tool.

From the curves we see that the power required varies directly as the amount of metal removed and is practically independent of the depth of cut on amount of feed. See Figs. 8 and 9. Submitted by W. C. North.

Wood-Working Machines.

Load on Test No. 1.—Motor with 64 ft. of 2 7/16 in. line shaft running in 9 standard hangers with ring oiling boxes, together with 161 ft. of single belting, 62 ft. of double belting, 7 loose pulleys and a 1⅛ countershaft 2 ft. 8 in. long, supported by oil boxes. Power input 2.84 kw.

Test No. 2.—Load the same as No. 1, together with a 24 in. J. A. Fay single belt driven surfacer, on 2 x 24 in. R. W. ⅛ in. deep cut at 16 ft. min., and 6 loose pulleys, 6 ft. 8 in. of 1⅝ in. counter shaft, supported in 4 oil boxes and 20 ft. of single belting. Additional power input 5.59 kw.

Test No. 3.—Load the same as No. 1, together with a 24 in. Valley City, 2-belt driven surfacer on 2 x 24 in. R.W. ⅛ in. deep cut at 32 ft. min., and 6 loose pulleys, 7 ft. 6 in. of 1⅝ in. counter shaft supported in 4 oil boxes and 20 ft. of single belting. Additional power input 5.84 kw.

Test No. 4.—Load the same as No. 1, together with 65 ft. of 2 15/16 line shaft running in 9 standard oil boxes and 301 ft. of 2½ in. single belting on 14 loose pulleys. Additional power 2.71 kw.

Test No. 5.—Load same as No. 1, together with all machines running idle; two single surfacers, 24 in. blade; 1 variety wood-worker, 9 in. blade; 10 speed lathes, 14 in.; 1 pattern maker's lathe, 20 in.; 1 mortiser; 1 grinder of 4, 12 in. emery wheels; 1 grindstone, 3 ft. dia.; 1 band saw; 1 circular saw. Together with 176 ft. of 1⅝ in. counter shafting running in 28 standard oil boxes and 244 ft. of single belting 2½ in. wide. Additional power input, 10.13 kw.

Test No. 6.—Load same as in No. 1, with 14 in. circular saw cutting on 2 in. O. P. at 7 ft. per minute, together with 6 loose pulleys, 6 ft. of 1⅝ in. counter shafting supported on 4 oil bearings and 12 ft. of single belting. Additional power input 1.02 kw. avg.

Test No. 7.—Load same as No. 1, with ¾ in. wide band saw cutting 2 in. O.P. at 24 ft. per minute (saw running on 36 in. wheel at 375 r.p.m.), together with 6 loose pulleys, 2 ft. 8 in. of 1⅝ in. counter shafting supported in 2 oil boxes and 14 ft. of single belting. Additional power input 1.84 kw.

Data on Motor.—Made by General Electric Company, two-phase induction, 25 h.p., class 8-20-900, type I Q., form L, cycles 60, volts 220, special No. 1895.

These tests were made in the wood shop of Stanford

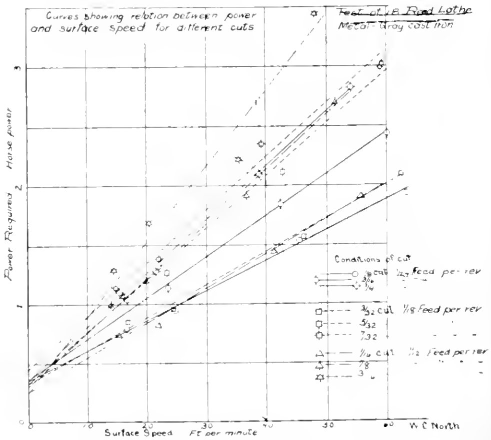


Fig. 9. Test of 18 in. Read Lathe Cutting Gray Cast Iron.

University, April 7, 1909, by C. L. Bradley, A. C. Coonradt, H. L. Hess, C. N. Hoskinson.

PHASE A			PHASE B							
Wattmeter.	Ammeter.	Voltmeter.	Wattmeter.	Ammeter.	Voltmeter.	Motor r.p.m.	Blast gage inches of water.	Exhaust gage inches of water.	Number of forges in operation.	Total power in KW.
7.01	35.25	225	6.57	32.	223	1190	7.2	2.70	8	13.58
7.66	36.0	228	7.44	34.5	229	1170	7.1	2.30	16	15.10
7.88	37.0	231	7.66	35.25	225	1155	7.0	2.10	24	15.51

Pressure Blower.

Test of a No. 7 Buffalo Forge Company's pressure blower and a 60 in. exhaust fan, manufactured by the same firm, supplying 24 standard 3 in. tuyer Buffalo forges.

Ducts are of sewer pipe. Main ducts, blast 14 in. dia.; main ducts, exhaust 24 in. dia.; most distant forge is 72 ft. from fans.

The most interesting thing in connection with this test is the fact that it takes practically no more power to supply the 24 forges than it does when only 16 are on.

Motor Data—Two-phase, 69 cycle, 20 h p., 220 volt, 1200 r.p.m Submitted by W. C. Cole.

Test of Exhaust Fan for Foundry.

No. 5 Buffalo draught fan furnishing the required draught for a 26 in. cupola, through a 10 in. pipe, 26 ft long, with three right angled bends in it, to 6 tuyers 4 x 6 in.

Length of time blast was on, 38 min.; iron melted, 1700 lb.; length of time before iron appeared after turning on the blast, 10 min.; amount of iron drawn off each time cupola was tapped, about 400 lb; number of times cupola was tapped, 5.

Motor Data.—10 h.p., two-phase, 60 cycle, 220 volt, 1200 r p.m

The motor was belted to a line shaft 16 ft. long, mounted on three floor brackets. The fan was belted to line shaft No load run was made with only line shaft belted to motor.

Test Data—

Time.	Total Power, KW.	Pressure
2:20	8.2	7
2:30	8.3	7
2:40	8.0	
2:50	7.45	6
2:53	7.6	5½
No load	1.26	

Submitted by W. C. Cole.

Test of Motor Driven Hacksaw.

Two-phase, 60 cycle, 220 volt induction motor. Saw—Length of stroke, 6 in.; number of complete strokes per min., about 60.

Volts per phase.	Current per phase.	Power, total, watts.	Power factor.	
238.9	.80	111.6	.29	No load
242.8	.825	149.6	.38	1½ in. cut in steel
239.5	.82	136.4	.35	2 in. cut in cast iron

Submitted 3-6, 1909, by A. J. Gowan, F. J. Hettman, A. B Cox.

Power Used by L. S. J. U. Machine Shop.

Power for shop tested is furnished by a 20 h p., two phase 60 cycle, 220 volt, 900 r.p.m. induction motor.

Measurements of the power required to drive the motor under the following loads were made:

A—Motor driving clutch pulley which ran loose on main shaft, 50 ft. of 8 in. belting, two ply.

B—Motor driving clutch pulley, clutch in, and 64 ft of 2 7 16 in. shafting running in 11 hangers with oil boxes All belts were off except the one connecting motor to clutch pulley as tested in A.

C—Load same as in B with the addition of 510 ft. of belting and 23 loose pulleys on countershafts.

D—Load same as B, together with 927 ft. of belting and the following machines running light.

Machines: Lathes—1 Jones & Samson turrett, 12 by 24 in; 1 20 in. lathe; 1 16 in. lathe, 2 14 in lathes, 1 12 in lathe; 1 Brown & Sharpe No. 3 cutter and reimer grinder, 1 Brown & Sharpe No. 1 universal grinder, 1 Cincinnati Milling Machine Co. No. 1½ milling machine, 1 12 in. emery wheel and buffer, 1 24 in. emery wheel, 2 14 in. emery wheels (same shaft), 1 24x72 in. planer, 1 16 in. crank shaper, 1 3 in centering machine, 1 36 in. grindstone, 1 W. S. & J. Barnes Co No. O friction drill press, 1 W. S. & J. Barnes Co. 26 in. drill press.

Results of Tests.

Part.	Power, KW.	Average Pf	Output H.P. Power.	Input H.P. Power.
* A	2.45	.221	.75	3.29
* B	2.20	.206	.50	2.95
C	3.24	.247	1.88	4.35
D	6.17	.480	5.55	8.28

*As shown by these results the friction of clutch pulley is greater than friction of shaft. The difference however is not great enough to start shaft from rest with clutch out, but will keep shafting running after it is started if the clutch is pulled out.

The h.p. output were found by means of an efficiency curve computed from the circle diagram for the motor.

Submitted by J. D. Taggart, H. M. Haver, E. P. Tallant.

WASHINGTON WATER POWER CO. REPORT.

Extensions and betterments contemplated for 1911 by the Washington Water Power Company are outlined in an exhaustive report submitted by D. L. Huntington, president, at the annual meeting of stockholders at Spokane, Wash., on February 6. The annual report shows that during the year the company relaid with 70-pound steel rails and paved between rails 11.09 miles of track, double-tracked 1.56 miles of road and extended lines 7.9 miles. They added 10 passenger cars and one work car and equipped the interurban railway lines with an automatic block signal system of the most modern and efficient type. Statistics covering the street railway system show:

	1909.	1910.
Miles of street occupied	15.26	48.79
Miles of track	100.96	108.92
Passengers carried	21,842,767	24,730,145
Car miles run	3,624,586	3,990,653
Car hours run	435,541	465,516

The foregoing statistics cover the whole system excepting passengers carried and streets occupied, which are for city lines only.

The comparative statement of the company for the years ended December 31, 1909, and December 31, 1910, is as follows:

	1909.	1910.
Outstanding stocks	$7,223,200	$9,390,100
Outstanding bonds	5,517,000	5,838,000
Notes and other debts	25,000	775,000
Gross earnings	2,758,712	3,155,223
Annual allowance for depreciation	273,600	311,100
Net earnings for stock	675,036	918,773
Surplus to date	860,499	1,071,011

A regular dividend of 7 per cent was paid in 1910 and an extra dividend of 1 per cent was paid January 3, 1911. A quarterly dividend of 2 per cent has been declared payable April 1 to stockholders of record March 15.

The power station at Little Falls was put in operation July 29, 1910. There are now installed there three generating units of 5000 kilowatts rated capacity, and the fourth unit will be placed in operation by midsummer of 1911. The storage battery station of the company was nearly completed at the close of the year and will be in operation early in 1911.

During the year 226,632 duct-feet of underground conduits were installed in the business district.

The company has purchased the lighting and power distributing system and business in the town of Colfax, Wash., and it is now operated directly by the company. The service has been improved, the street lighting entirely changed, and public sentiment shows decided appreciation of the new ownership.

An extension of the high tension transmission lines, has been made to Odessa, and a local distributing system has been installed and is being operated by the company, with results satisfactory to the residents and to the company. The desire of the residents of these towns for the direct ownership and operation of the local lighting plants by a large and responsible company, instead of through leases of power to local owners, is an interesting and important sign of the times.

The greatest undertaking of the year has been the acquiring of new water rights on the Spokane River at a point four miles above Little Falls, and the commencement of construction there of the largest of the company's power stations, to be known as Long Lake stations. The development contemplates the erection of a solid concrete dam giving a fall of 170 feet and forming a lake about 23 miles in length and nearly three-eights of a mile in average width. An interesting form of movable roller dam, considerably used in Europe, but not heretofore adopted in the United States, will be used for the purpose of discharging flood water and regulating the water level of the lake.

The installation will consist ultimately of four generating units of 12,500 kilowatts (16,666 electric horsepower) each, connected to turbine water-wheels, with a capacity of 22,500 horsepower each. These water-wheels will exceed in size and capacity any other now in existence. Two such units will be installed at first, and the others will be added as required. It is hoped to have this plant in operation by the fall of 1912. The plant when completed will more than double the hydraulic power capacity of the company.

During 1910 the outstanding capital stock of the company was increased April 1 by the issue of 30 per cent at par, from $7,225,200 to $9,390,000, and a further issue of 25 per cent was taken January 3, 1911, making the total amount now outstanding $11,737,600. In anticipation of the stock issue of January 3, 1911 the company borrowed in all $775,000 toward the end of the year, which was paid off January 3.

ELECTRICITY IN RURAL DISTRICTS.

Data is now being collected by a special committee of the National Electric Light Association from which to prepare a report on the use of electricity in rural districts. This committee, whose Pacific Coast member is S. M. Kennedy, general agent of the Southern California Edison Electric Co., Los Angeles, requests information on this subject from every company and individual knowing of any novel or special use to which electricity is being applied on the farm. Engineering details are unnecessary, merely a photograph and brief description.

CALIFORNIA PUBLIC SERVICE COMMISSION BILLS.

In response to a number of requests a summary of Senate Bill No. 464 and Assembly Bill No. 671 is here presented.

These bills create a commission to be composed of three members to be appointed by the Governor for four-year terms at an annual salary of $8000 each. The commissioners are to devote their time exclusively to the work of their commission and are prohibited from holding any stock or bonds or to hold official relations with corporations subject to their supervision. One commissioner must be a lawyer and one other "a man familiar with or having knowledge of one or more branches of the public service business."

The commissioners have power to appoint counsel at a $5000 salary, a secretary at $4200 salary and all necessary employes.

Offices are to be maintained in San Francisco and stated meetings are to be held at least once a month, all sessions and all records being open to the public. Annual reports are to be issued containing a copy of all orders and determinations.

The commission shall have power to inquire into and investigate all public service business except railroads, having the supervision of the manner in which they are conducted, to prescribe the form of reports and uniform methods of accounting. They shall also determine reasonable rates for service from both private and municipal plants and prescribe adequate safety devices, companies affected paying all costs of investigation.

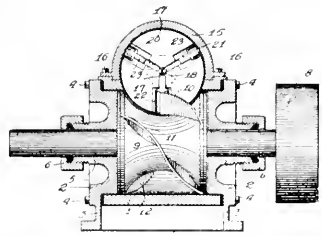
Furthermore they shall have full power "to examine and inquire into all issues of stocks, bonds and other evidences of indebtedness, * * and to publish the facts concerning the same," to issue or deny permits for making expenditures and sales or leases. They may order necessary repairs, additions, changes or improvements, inspect all equipment and all company records, make valuations, fix service standards and issue permits and licenses.

All rates, tolls, charges and schedules fixed by the commission shall be in force until otherwise found by a competent court of jurisdiction. Fines of from $100 to $1000 as provided for non-compliance with the commission's orders. This act includes in its provisions the business done by "railroad companies, street railway companies, ferry companies and express companies in the transmission or transportation of passengers, freight or express, and by telephone and telegraph companies in the transmission or conveyance of telephone or telegraph messages, and by pipe line companies in the transmission, for others, of oil or other fluids by pipe line, and by light, heat, water or power companies in the supplying, delivering or furnishing of light, heat, water or power."

Senate Bill No. 465 and Assembly Bill No. 672 provides for an amendment to the Civil Code to be ratified by the voters of the State in order that this public service commission law be thus legalized.

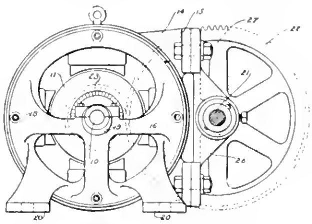
PATENTS

983,365. **Pump.** Byron W. Haskell, Oakland, Cal. In a pump of the character described, a cylinder, a rotary piston having spiral blades, and a rotary disk projecting into said



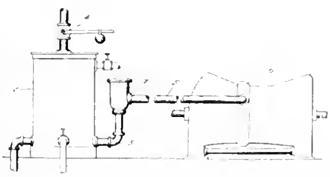
cylinder bearing against said piston and having openings with movable covers adapted to be engaged in by said spiral blades, said rotary disk being located between the inlet and outlet ports of the cylinder.

983,361. **Back-Geared Motor.** Alexander M. Gray, Milwaukee, Wis., assignor to Allis-Chalmers Company. In a dynamo-electric machine, a main shaft, a frame comprising a field yoke and end heads which have supporting portions and



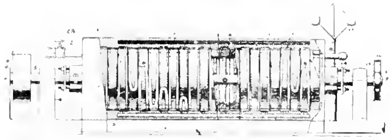
which are secured to the yoke and support the main shaft, and a counter shaft supported on the yoke, said end heads being stationary and said yoke being adjustable relatively thereto.

983,282. **Feed-water Heater.** Francis Hodgkinson, Edgewood Park, Pa., assignor to the Westinghouse Machine Company. The combination with a feed-water heater and its



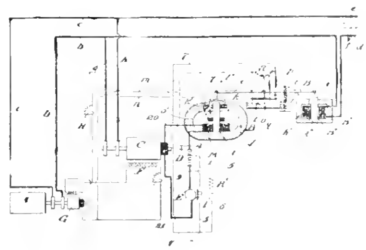
supply pipe, of a turbine adapted to receive and utilize steam from said heater and means for controlling the fluid pressure in said heater and for delivering fluid therefrom to said turbine.

983,653. **Turbine.** Byron Stevens, Oakland, Cal. In a steam turbine, the combination of a shaft, wheels secured on said shaft, a casing for the turbine, disks secured to the casing and alternating with the wheels, the peripheries of the disks and wheels being formed with ports and passages respectively, each port and passage leading from one side of the disk or wheel to the other, each port and passage having its inlet and outlet portions extending in nearly opposite direc-



tions, each port and passage being open at its side to the adjacent wheel or disk, the inlet portions of the ports and passages, and also the outlet portions thereof, opening in opposite directions, the outlet portions of the passages being of sufficiently greater sectional area than of the inlet portions thereof to cause the pressure fluid flowing through the passages to flow into the outlet portions of the passage with a velocity greater than in the inner portions thereof by slightly more than twice the velocity of the periphery of the wheels, substantially as described.

983,670. **Alternating-Current System of Distribution, Regulation and Control.** Joseph Bijur, New York, N. Y., assignor by mesne assignments, to The Electric Storage Battery Company, Philadelphia. The combination of an alternating current source of supply, an alternating current work circuit, a storage battery to compensate for variations in the load, regulating means responsive to both the variations in the work



circuit and the direction and amount of current of the storage battery, and operated by variations in the work circuit, said regulating means starting to operate when the load on the work circuit varies from the average and continuing to operate until the energy given out by the battery or absorbed thereby compensates for the increase or decrease of energy demanded by the work circuit.

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POWER AND GAS

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E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
604 MISSION STREET, SAN FRANCISCO

EASTERN OFFICE, 140 NASSAU STREET, NEW YORK
C. N. MANFRED Eastern Manager

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas" Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Legislation

As most electrical work is known to be dangerous, employers have usually provided every reasonable protection for those engaged therein. Expense has not hindered the installation of any safety appliance or protective device likely to reduce the life hazard of electricity. Statistics show, however, that a large proportion of the unfortunate accidents among electrical workers may be traced to the carelessness of men who know better, but who have become contemptuous of the danger involved. For such neglect in observing ordinary care no adequate protection can be offered.

Notwithstanding the fact that electric companies have voluntarily done their utmost to minimize the number of accidents, three bills have been introduced at the present session of the California legislature to compel the companies to reconstruct practically every pole line in the State. Ostensibly these bills are meant to lessen the danger associated with the lineman's occupation, but in reality they are said to be intended to provide more work for these men.

The most radical requirements of the bills are a twenty-six-inch spacing between all overhead conductors and an insulated or grounded guard-wire beneath all high-tension circuits of 15,000 volts or more. While there is some recent construction where wires have been thus strung, there are thousands of miles of line which would have to be rebuilt in order to comply with these rulings. The most absurd suggestion is that no street manhole be placed within three feet of an electric railway track, so that the workmen may not be injured by a passing car. That this spacing is almost physically impossible is indicated by the fact that there are corners in San Francisco where as many as forty-six manholes are in use.

The bills have met with great opposition, not so much on account of their requirements for new work as because of their retroactive effect on all old work. They propose an immediate revolution instead of a gradual evolution whereby changes could be made in the ordinary course of reconstruction. Furthermore, if the proposed public service commission is established the commissioners will have full power to order any changes that are necessary to protect life or property, and these new laws would be unnecessary.

As there is far greater likelihood that the public service commission act will be passed than that these special electrical laws will be enacted, we would suggest that their sponsors might well lend their support to the broader measure with the assurance that an impartial board of public service commissioners will give careful attention to protecting the lives not only of electrical workers, but also of the general public. However, even should these bills pass the legislature, they contain a number of illegal provisions which would soon nullify all others when the matter was passed upon by the courts. Their enforcement means the ruination of all farmers' telephone lines and many small companies, as well as the serious embarrassment of the larger ones. How this can permanently help the electrical worker we fail to see.

PERSONALS.

S. K. Colby, vice-president of Pierson, Roeding & Co., is in the Pacific Northwest.

F. A. Cressey, manager of the Modesto Electric Company, visited San Francisco this week.

L. F. Wyman has been appointed electrical engineer of the Loyal Railway at Ballard, Wash.

R. G. Arthur has been made general manager of the Douglas Street Railway at Douglas, Ariz.

C. R. Downs, who is interested in a lighting company at Sutter Creek, recently arrived at San Francisco.

Dr. E. S. O'Brien, who has electric lighting interests at Merced, was a San Francisco visitor during the past week.

R. S. Chapman, an engineer interested in hydroelectric developments, has arrived at San Francisco from Portland.

R. L. Noggle has been appointed superintendent of the Northern Idaho and Montana Power Co. at Sand Point, Idaho.

C. F. Flinn, of the Allis-Chalmers Company's sales force, has returned to the San Francisco office after a Northern California tour.

A. C. Sprout went to Stockton last Tuesday on business connected with electric pumping in the San Joaquin reclamation districts.

K. T. Roebling, of the wire manufacturing firm of John Roebling & Sons of Trenton, N. J., is visiting their San Francisco branch house.

N. M. Fruehauf has succeeded Chas. E. Watkinson as acting auditor of the San Francisco, Vallejo and Napa Valley Railroad, Napa, Cal.

Ray Fulcher, construction engineer with Sanderson & Porter, is inspecting the Relief Creek dam of the Sierra & San Francisco Power Co.

T. D. Petch, manager of the Santa Rosa district of the Pacific Gas & Electric Company, has resigned and will be succeeded by M. G. Hall.

Frank H. Varney, engineer of operation in the Pacific Gas & Electric Company's steam plant department, left last week for a month's Eastern trip.

C. F. Pearson, general superintendent of the Southern California Edison Electric Company of Los Angeles has been spending several days at Sacramento.

H. E. Adams, the Stockton manager of the Western States Gas & Electric Co., an H. M. Byllesby & Co., interest, has moved into elegant new offices on the corner of Weber and Sutter streets.

E. G. Dewald, of the Pelton Water Wheel Company selling corps, is at Tacoma in connection with the bidding on the new municipal hydroelectric plant known as the Nisqually River development.

L. S. Twomey has been appointed Pacific Coast representative of the engineering department of the National Electric Lamp Association with headquarters at 1648 Sixteenth street, Oakland, Cal.

M. S. Hopkins, of the Clark syndicate, which now controls the Portland Railway, Light and Power Company, as well as electric plants in St. Louis and Eastern cities, is visiting Portland, Ore., from Cleveland on an inspection tour.

R. H. Sperling, general manager of the British Columbia Electric Railway Company, has arrived at San Francisco from Vancouver. He will also tour Southern California while reviewing the latest developments in electric railway transportation and power work.

E. N. Sanderson, of the firm of Sanderson & Porter, has left for the East via Los Angeles and Albuquerque, N. M. He has been inspecting the company's various plants throughout the Pacific Coast.

F. F. Barbour has resigned as assistant to the president of the Portland Railway, Light & Power Company and on March 1 he will become assistant to the president of the Pacific Gas & Electric Company at San Francisco. He was for a number of years at the head of the sales department in the General Electric Company's San Francisco office.

M. C. McKay, superintendent of the Sierra & San Francisco Power Company's Stanislaus Division is at the San Francisco office from his headquarters at the Stanislaus hydroelectric plant near Vallecito. There have been no interruptions to the service from weather conditions this winter, notwithstanding the unusually heavy snowfall in the mountains.

Newly elected associate members of the American Institute of Electrical Engineers include E. S. Code, engineer Westinghouse Electric & Mfg. Co., Seattle, Wash.; Chas. L. Easton, superintendent of power, San Joaquin Light & Power Co., North Fork, Cal.; Austin B. Gates, Alhambra, Cal.; H. B. Hatfield, city foreman underground department, San Francisco Gas & Electric Co., San Francisco, Cal.; G. L. Hedges, designer Kelman Electric & Mfg. Co., Los Angeles, Cal.; M. R. Lott, electrical engineer Telluride Power Co., Provo, Utah; P. D. Naugle, electrical machinist, and Richard Nightingale, draughtsman at Puget Sound Navy Yard, Bremerton, Wash.; Roy Page, draughtsman Southern Pacific Co., San Francisco, Cal.; J. T. Percival, Jr., electrical draughtsman, Washington Water Power Co., Spokane, Wash; L. W. Roush, secretary and engineer Gunnison Valley Power Co., Gunnison, Utah; J. A. Runchey, superintendent power house, Washington Water Power Co., Reardon, Wash.; H. A. Seabright, electrical engineer, Idaho Electric Supply Co., Boise, Idaho; W. P. Shippee, superintendent of power, U. S. Reclamation Service, Spanish Fork, Utah; Frank S. Warren, construction department, Pacific Gas & Electric Co., San Francisco, Cal.; E. A. West, Jr., assistant engineer, Portland Railway, Light & Power Co., Portland, Ore.

PACIFIC COAST A. I. E. E. MEETING.

Preparations for the Pacific Coast meeting of the American Institute of Electrical Engineers at Los Angeles, Cal., on April 25, 26, 27 and 28, 1911, are now being made by the local committee appointed by President Jackson, consisting of the following members and associates: Los Angeles Section—J. E. Macdonald, chairman; S. H. Anderson, V. L. Benedict, I. T. Dyer, O. H. Ensign, J. A. Lighthipe, E. F. Scattergood. Associate members of the committee—A. H. Babcock, San Francisco, Cal.; S. G. McMeen, San Francisco, Cal.; C. L. Cory, Berkeley, Cal.; H. J. Ryan, Stanford University, Cal.; L. B. Cramer, Portland, Oregon; A. A. Miller, Seattle, Wash.; J. B. Fisken, Spokane, Wash.

Important papers will be presented under the auspices of the high tension transmission, railway, and telegraphy and telephony committees, which are expected to give valuable information regarding Pacific Coast practice in various developments. All members who contemplate a trip to California will find this a desirable opportunity as the local electrical companies are co-operating with the committee to promote every facility for the information and entertainment of visitors. The program will include trips to Edison plants and excursions to Santa Ana Canyon, Mount Lowe, and probably Catalina Island. Additional details will be published later, but inquiries will receive attention if addressed to V. L. Benedict, Local Secretary, Los Angeles Fire Alarm Company, Los Angeles, Cal.

INDUSTRIAL

A LARGE EQUIPMENT OF FEEDER REGULATORS.

Where an alternating current central station is in competition with a direct current plant in a large city, conditions are often unfavorable to the alternating current proposition. The chief disadvantage arises from the sensitiveness of the voltage regulation to any changes in load. Where a large part of the load is made up of elevators or other machinery requiring frequent starting, an alternating current

Automatic Feeder Regulators.

line is apt to suffer considerably more from fluctuations in voltage than is an equivalent direct current. The direct current system suffers only from line drop, while the alternating current line has the line drop of resistance and reactance and in addition an actual reduction of voltage at the generators or transformers due to the wattless current at the low power factor of starting. A load that would produce a fluctuation in a direct current line of two or three per cent might under some conditions cause as much as twenty per cent fluctuation in an alternating current line. In such cases the use of feeder regulators remove entirely this disadvantage of the alternating current system and in many cases gives even better regulation than is obtainable with a direct current system.

A case in point is that of the United Electric Light & Power Company of New York. The 146th Street sub-station of this company supplies a load made up largely of apartment house equipments, consisting mostly of lights and elevators. The voltage fluctuation on the feeders due to the starting of elevators, put such a heavy drawback on the service as to make competition with the direct current systems in the city, equipped with storage batteries and other equalizing devices, almost impossible. Equipping the system with feeder regulators, however, has not only resulted in marked benefits but has made the service preferable to that of the direct current system.

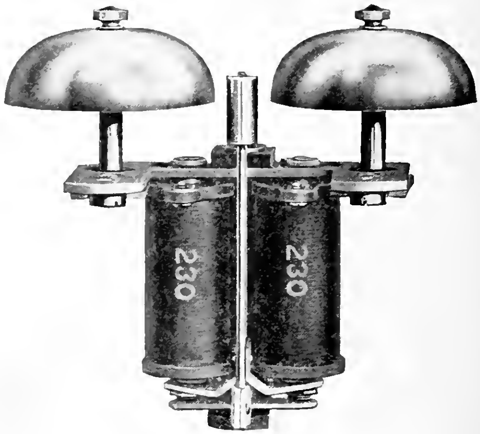
The regulator equipment consists of 20 two-phase automatic induction type feeder regulators, manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburg. Each regulator is of 85 kva. capacity and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a 220 volt 4/10 h.p. Westinghouse direct current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators.

The results obtained are in some ways remarkable. So sensitive are the relays that the voltage at the service point at no time varies more than one per cent. The automatic operation is practically instantaneous, and lights, even in the same building with the elevator that is started, barely show a flicker. The voltage at the station end of the feeder, however, varies as much as 15 per cent showing the part played by the regulators in smoothing out the voltage curve.

The accompanying illustration shows a photograph of 11 of these regulators in operation. The regulators are of the standard induction type manufactured by the Westinghouse Company. The regulation depends on the angular position of a rotatable secondary core and winding relative to a stationary primary core and winding, the two windings being connected in series. Rotation of the secondary is produced by the small motor at the top of each case, controlled by the relays. The adjustment of voltage is gradual, which corresponds to practically an infinite number of steps. Each regulator is self-contained and cooled by air blast, with which the station is amply supplied for cooling its transformers.

A NEW HARMONIC RINGER.

The Western Electric Company has recently placed on the market a new harmonic ringer, which has proven from actual service that it will satisfactorily meet the most exacting conditions.



No. 41 Type Western Electric Harmonic Ringer.

This ringer, known as the No. 41 type, operates on the same potential of 140 volts for all four frequencies. This simplifies the harmonic ringing system and eliminates the use of the higher voltages, which have been objectionable in low voltage telephone circuits and apparatus.

The construction of this ringer is such that no armature adjustment is required after it leaves the factory. The

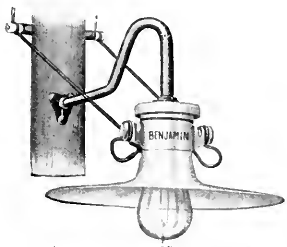
adjustment of the gongs can be quickly, easily and accurately made by means of an eccentric screw. After the adjustment is once made the gongs can be rigidly and permanently set by tightening the screws which lie directly behind the adjusting screw. The very simplicity of the adjustment of this ringer is a unique feature, as the only tool required is an ordinary screw-driver, which every repair man carries in his pocket.

The coils of this ringer are wound with black enameled wire, which makes them practically impervious to moisture. This enamel insulation will stand a temperature that would destroy the usual silk and cotton insulation. Because of the decrease in the overall diameter of the wire, due to the use of enamel insulation, the ringer coils can be wound to a much higher efficiency.

Every detail in this ringer has been especially designed for strength, durability and ease of adjustment with a view of practically eliminating the factor of ringer maintenance in Harmonic Systems.

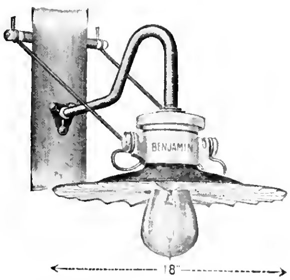
BENJAMIN HIGH VOLTAGE STREET SERIES (FILM CUT-OUT) LIGHTING UNITS.

The Benjamin Electric Manufacturing Company is attracting attention by a number of new street series lighting fixtures which they are placing upon the market. Representative cuts of both fixtures and sockets are shown with the accompanying descriptive matter.



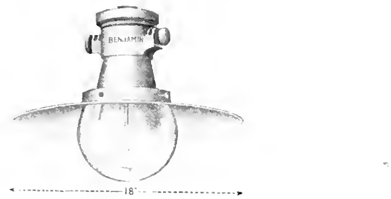
18-in. Flat Cone Reflector.

The socket consists of essentially three porcelain parts: (1) A central or body portion with integrally formed knobs; (2) A lower removable bushing carrying the threaded socket shell and film cut-out spring; (3) A surmounting petticoat insulator.



18-in. Radial Wave Reflector.

The base portion has a center bore in which are located the center spring and short-circuiting contact, together with means for co-operating with the lower or removable portion. Beneath the knob are grooves forming protected and insulated passages for the wires. On the upper side of the base there is an iron fitting supported by four screws deeply counter-sunk in porcelain. Between the two is a rubber disc. The lower part may be inserted by merely pushing it forward and turning to the right, or removed by pulling it outward and turning to the left. It cannot become disconnected by turning the lamp. The petticoat insulator is held in position by a lock nut and washers passing over the upper end of the fitting, thus making a water-tight joint. The device is thus a combined



18-in. Flat Cone Reflector and Globe.

socket, cross arm and insulator, with three distinctive features: (1) Compactness; (2) strength; (3) high insulation. It is supplied for span wire suspension, or with fitting adapted for gooseneck or other $\frac{3}{4}$ in. pipe connections. The reflectors used are thoroughly insulated from the support. They are attached by means of four screws passing through holes cemented in the back. Cat. No. 1521 shows an 18 in. flat cone reflector; Cat. No. 1491 an 18 in. radial wave reflector; Cat. No. 1581, an 18 in. flat cone reflector incorporating a globe holder, and an 8 in. by $6\frac{1}{2}$ in. glass globe. Prices and discounts, together with further descriptive information, may be secured by addressing the company's office at 151 New Montgomery street, San Francisco, Cal.

THE ROUND TABLERS.

Mr. A. N. Fox, manager publicity department of the Benjamin Mfg. Co., Chicago, has been elected chairman of the "Round Tablers," a newly organized group of advertising men who meet once a week in the rooms of the Chicago Advertising Association for the purpose of a systematic study of the various phases of trade publicity.

Fearless and wide open discussion is the slogan of the organization. After an address by an invited speaker the meeting is thrown open to those present, and the subject under discussion analyzed with particular regard for securing definite, concrete, and practical results. During December the following topics were taken up: "Large Space In Advertising," R. R. Shuman; "Style In Advertising," A. B. Jensen; "Cultivating The Dealer," S. DeWitt Clough; "Planning a Campaign," Frederick A. Farrar.

Stenographic reports of the meetings are taken and transcripts furnished the various members of the organization.

The other officers for the ensuing three months are Vice-Chairman, Mr. Frederick A. Farrar; Secretary, Mr. G. G. Place.

TRADE NOTES.

The Oakland Traction Co., Consolidated, has purchased from the General Electric Co. 60 two-motor car equipments with type K 36 controllers. The motors are 60 h.p. each.

Reckhill & Victor, of Shanghai, China, have ordered from the Westinghouse Electric & Manufacturing Company a 150 h.p. alternating current, induction, slip ring motor, and a water rheostat to be used in operating a flour mill.

Through Shewan, Thomas & Company of Pekin, the Chinese Government has purchased two 150 kw. direct current generators and a nine-panel switchboard from the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. The generators will be installed in the Bureau of Engraving and will supply power for motors and lights.

NEWS NOTES

INCORPORATIONS.

COALINGA, CAL.—The Coalinga Domestic Water Company has been incorporated with a capital stock of $10,000 by F. Cheney, C. N. Sanderson and R. L. Peeler.

LONG BEACH, CAL.—The Long Beach Water Company has been incorporated by G. H. Bixby, a director of the Alamitos Water Company.

SPRINGDALE, WASH.—The Chamokane Contracting Company has been organized to construct an electric railroad between this place and the proposed power plant of the Washington Water Power Company on the Spokane River.

FINANCIAL.

SILVERTON, ORE.—This city has voted to issue bonds to the amount of $75,000 to be used for the construction of a water system.

WILLOWS, CAL.—The City Trustees have decided that on March 1st, the bonds recently voted for municipal improvements will be sold. Immediately after the disposal of the bonds work will be commenced on the city hall, which is to cost about $25,000.

TRANSMISSION.

TOPPENISH, WASH.—The Valley Light and Power Company is extending its lines to Zillah, Wash.

POCATELLO, IDAHO.—Flood waters in the Portneuf River wrecked the substation and transformer house of the Idaho Consolidated Power Company here.

PETALUMA, CAL.—The proposed gas plant for the city to take the place of the "Piped from Santa Rosa" gas for this city is now assured and work will be under way within a very short time.

VALE, ORE.—Plans are under way whereby within two months Vale will be connected with the power plant on the Malad River, Idaho. The plant belongs to the Telluride Company, Salt Lake City.

VANCOUVER, WASH.—The Mt. Hood Railway & Power Company has asked a franchise to erect poles, string wires and furnish power in the city. Plans are under way to lay a cable under the Columbia from this place to Portland.

LOS ANGELES, CAL.—The Navidad Mines & Reduction Company in San Sebastian district at Jalisco will soon install a hydroelectric plant on Ameca River capable of generating 800 horsepower. The plant will cost about $150,000.

LODI, CAL.—At the meeting of the Merchants' Association last week A. V. Friedberger, W. H. Thompson, and S. H. Zimmerman, were appointed a committee to interview the business men of this place regarding the proposed street lighting system.

WATSONVILLE, CAL.—In the proper spirit of expansion The Coast Counties Light & Power Company of this city is extending its power lines in this valley. In Green Valley the line will be extended three miles to the Litchfield place about seven miles from this city.

PORTLAND, ORE.—Bids will be received at the office of Bridges & Webber, architects, room 122 Hamilton building, Portland, Oregon, until 10 a. m., February 19, 1911, for the erection of a main building and power house for Multnomah County, at Multnomah Farm, one mile west of Troutdale, Ore.

MARTINEZ, CAL.—Light, heat and power are to be furnished the towns of the county and the manufactories along the water front by the Great Western Power Company, which has signified its intention to enter Contra Costa County by applying to the Martinez trustees for a franchise. The new corporation, since its organization has carried its electric power from the Sierra to the bay cities along the main line, which stretches across Contra Costa County. The only local service which the company has given is at the works of the Cowell Cement Company at the base of Mt. Diablo.

COLUSA, CAL.—For the purpose of furnishing water sufficient to irrigate 40,000 acres of land in Colusa County, west of Williams, and to generate electric power, three water appropriations have been filed by Byron D. Beckwith of this city on Freshwater and Bear creeks, Colusa County, and on Cache Creek in Lake County. It is proposed to build a dam on Bear Creek and utilize the lower end of Bear Valley as a reservoir. A tunnel through the hill from Bear Valley into the head of Freshwater Creek to divert the water past Mountain House, utilizing it at the outlet of the tunnel for the production of power, is planned. Below the Mountain House the same water would be used for irrigation. Three power stations, all on one line, are proposed.

ILLUMINATION.

SPRINGFIELD, ORE.—The Oregon Power Company plans to make Springfield and Junction City models for street lighting. The new lighting will be a tungsten system.

NEWPORT, CAL.—The City Council passed a resolution declaring that public interest demands the erection of a municipal light plant in this city and $55,000 in bonds will be issued to cover the cost of the plant.

REDLANDS, CAL.—City Engineer Hinckley has completed plans for installing a system of ornamental street lighting on Orange street from Colton and on Cajon to Olive and on State, Second and Citrus avenue, from Third to Sixth street, at a cost of $15,000.

PASCOL, WASH.—The Pacific Power & Light Company has petitioned the City Council for vacation of a portion of Riverside addition which will be secured by this corporation for a site for a $400,000 electric switchboard and gas plant, to be constructed in the near future.

TRANSPORTATION.

SPOKANE, WASH.—The Spokane Traction Company during the year will build 2½ miles of new street railway.

WHITTIER, CAL.—The Pacific Electric Railway Company will double track its line on West Philadelphia street to the State school.

COEUR d'ALENE, IDAHO—Eastern capital will ask the city for a franchise for the construction of an electric street railway here.

COEUR d'ALENE, IDAHO.—The Inland Empire railroad will soon extend the tracks of their electric railroad to the shores of Fernon lake.

SAN RAFAEL, CAL.—A petition has been presented by Geo. D. Shearer, asking for a franchise to operate an electric railroad over the streets of this city.

OAKLAND, CAL.—A bill has been passed to print granting the Oakland Traction Company a franchise for a street railroad along and upon Nineteenth avenue.

RAYMOND, WASH.—J. D. Crary of the Twin City Electric Company has accepted the franchise for the construction of an electric street railway system here; work to start in April.

PUYALLUP, WASH.—R .S. Boyce of Hopokus, N. J., is sounding valley capitalists and property owners on the support they will give toward the construction of another interurban line between this place and Tacoma.

LOS ANGELES, CAL.—Property owners on Main street, from Thirty-seventh street, to Manchester avenue, have filed a petition asking the City Council to induce the street railway company to run car tracks down their street.

ALAMEDA, CAL.—The Southern Pacific has begun placing poles in Clement avenue to carry power from the tidal canal to the termination of the loop line in Webster street. The work will be rushed in order to have the power ready when the Alameda local lines are electrized.

LOS ANGELES, CAL.—The Los Angeles Railway Company has applied for a franchise for a crosstown car line. Two routes have been submitted; one from Fourth and Vermont to east city limits, the other on Vermont to Jefferson, east to Central, south to Vernon and east to the city limits.

PORTLAND, ORE.—Bids will be received by Engineers Smith, Kerry & Chace, 611 Commercial building, for clearing the right of way on the Mt. Hood Railway Power Company's transmission line across the Sandy River valley. Work consists of clearing 22 acres and to be completed May 1. Specifications may be obtained from the office of the Mt. Hood Railway & Power Company, at Portland.

LOS ANGELES, CAL.—Announcement of the operation under one management of the Pacific Electric, Los Angeles and Redondo, Redlands Central and Riverside and Arlington Railway Companies and of the Los Angeles Pacific and San Bernardino Traction Companies is made in a circular issued from the Los Angeles office of Paul Shoup, vice-president of the Southern Pacific, owner of the several properties, and director of its electric railways.

MARTINEZ, CAL.—The Oakland and Antioch Railroad is to be extended to the slopes of Mount Diablo, in accordance with the agreement of the officers of the corporation to haul the rock to be quarried from the Martin ranch, which is to be purchased by the Spreckels company of San Francisco. It was first reported that the San Francisco concern was to establish a cement plant on the ground, but it is now announced that a quarry is to be built.

PETALUMA, CAL.—The City Council has granted to the Petaluma and Santa Rosa Electric Railroad Company a franchise to operate a line through the city. The company agreed in its franchise that if the road was not completed to Point Pedro within four years from the date of the granting, with ferries running to San Francisco, the franchise will lapse. The object of the railroad company is to build to Point Pedro and connect with San Francisco by fast ferries. The line will be operated on Water street, skirting on the river banks, which the company will improve and save the city of Petaluma over $10,000.

FRESNO, CAL.—F. S. Granger, vice-president, and W. D. Mitchell, secretary of the Fresno, Hanford and Summit Lake Railroad Company have returned from New York bringing with them signed contracts from the Hudson Counties Construction Company and Guaranty Trust Company of New York by which $1,250,000 has been secured to build an interurban railroad from Fresno to Kingsburg with a branch to Sanger. The road will be 35 miles long. The contract was signed January 28 and provides that construction shall start within 30 days. William McLean, chief engineer of the Hudson Counties committee, is en route to Fresno and immediately upon his arrival work will be started.

SACRAMENTO, CAL.—Vice-President John A. Britton of the Pacific Gas & Electric Company has agreed to build the loop as suggested by property owners along the proposed line from Twenty-eighth and P streets to the Elmhurst railway provided a bonus, the exact amount of which has not been made public, is paid to the street railroad company. The plan is to construct a line, starting at Twenty-eighth and P streets, running to the east end of Homestead through the Williamson tract and into Elmhurst.

SAN FRANCISCO, CAL.—The public utilities committee of the Board of Supervisors has recommended that an additional $600,000 of Geary street railroad bonds be offered for sale. The action was taken upon notification from the city engineer's office of the Board of Public Works that $600,000 would be soon needed that the work on the municipal project may not be delayed. The proposals for early construction and the amounts to be expended are as follows: Special track work $60,000; lands for power house and substation, $140,000; cars, $300,000; track construction and overhead work, $300,000; construction of buildings, $80,000; total, $880,000. Out of the proceeds of $500,000 of bonds already sold, $218,000 has been set aside to cover part of the above estimates, leaving $600,000 needed for immediate use.

SAN FRANCISCO, CAL.—The United Railroads Company has issued a report of the gross earnings of the street railway system for December last and for the year 1910. The document shows in part that the company during last year carried 153,069,780 paying passengers. This is an increase of 3,850,180 passengers over the preceding year, a gain which is considered a healthy one and indicative of the general good condition of the city. Put in another way, this large travel means that last year the United Railroads system had a daily average of 419,370 paying passengers and a monthly average of 12,755,817. In December last the company earned gross $682,356, or an increase of $36,509 over the same month in 1909. For the twelve months of 1910 the gross earnings amounted to $7,653,489, as compared with $7,455,965 the year before. This represents an increase of $197,524.

WATERWORKS.

REDMOND, ORE. The City Council is considering the question of building a gravity water system.

MADERA, CAL.—The City Trustees have adopted plans and specifications for an overhead water system.

CHICO, CAL.—The Chico Water Supply Company has submitted to the Trustees its annual report showing an investment of $175,834.28; receipts of $25,600.53, and expenditures of $30,260.94.

SEATTLE, WASH. The Council has passed a resolution providing for the improvement of West Eightieth street, West Eighty-first street, and West Eighty-second street, West Eighty-third street and West Eighty-fourth street by laying water mains.

BRAWLEY, CAL.—Within ten days, the first work will commence on the new water system of the city, the contract having been signed with G. A. Rogers of Los Angeles. This city will also purchase the system installed here by the Brawley Water Company.

FRESNO, CAL.—The annual statement of the water company for the year 1910, filed with the City Trustees, shows as earnings and expenses of the company the following figures: Earnings: Water furnished, $113,365.20; miscellaneous, $1,521.49; fixed charges, $82,938.72; net earnings, $31,947.97. Value of plant, less depreciation for 1910 at rate of 3.26, $274,228.63; expenditures for extensions and improvements, $9,542.07; value of plant $263,770.70.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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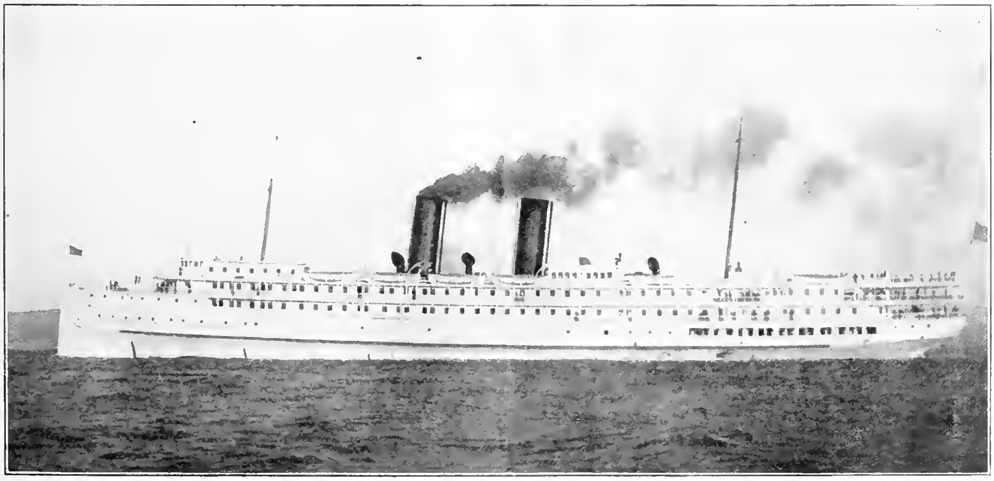
OIL BURNING TURBINE STEAMERS

The Pacific Navigation Company's steamships "Yale" and "Harvard" are triple-screw vessels, turbine-driven and oil fired. These steamers, which were formerly on the run between New York and Boston were brought around the Horn last year and are now running regularly between San Francisco and San Pedro, whence it is but a short ride by electric car to Los Angeles. The boats maintain an average speed of 22 knots, the trip being made in 17 hours.

first turbine driven vessels on the Pacific Coast, being among the first to be built in the United States. Though originally designed for burning coal, they were changed to oil-burners while yet on the Atlantic Coast, being the pioneers in this field. Besides the absence of soot and coal dust, the change made a great saving in space, reduced the firing force from 48 to 12 men and made possible a more even steam pressure and consequently more constant speed.

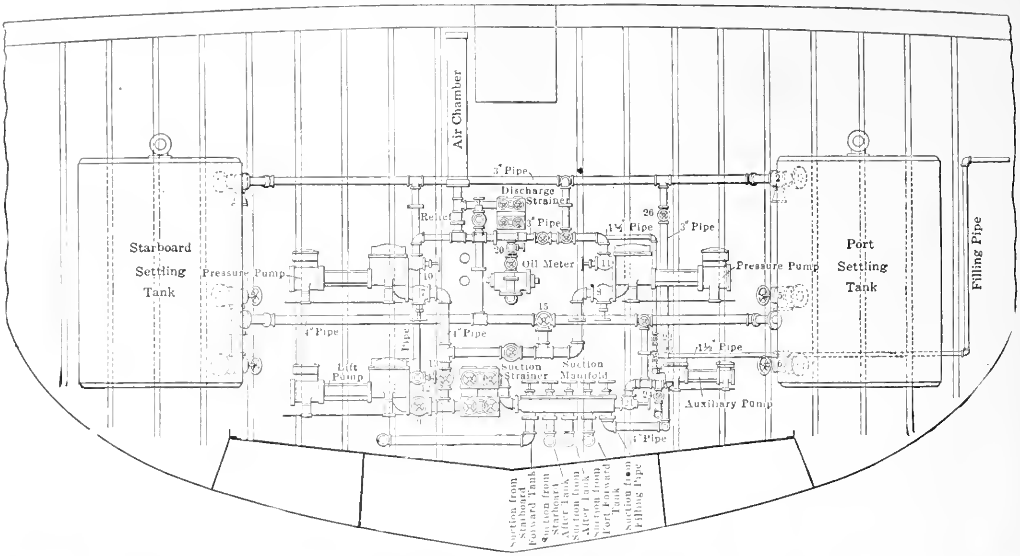


The Oil Burning Turbine Steamship "Harvard."

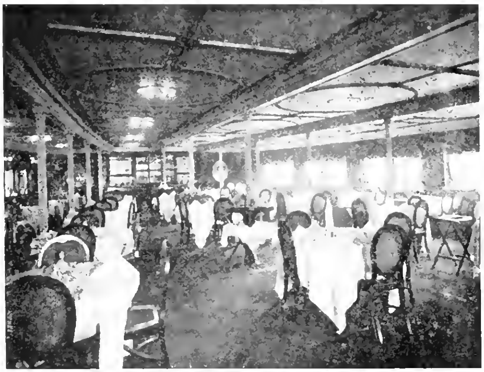
The "Yale" and "Harvard" are sister ships, a description of one sufficing for the other except for the blue furnishings of the former and the red carpetings and upholstery of the latter. The hulls were designed and the models tested at Denny's ship-yards, Dumbarton, Scotland, and the ships built at Chester, Pa. The turbines were installed and the super-structure completed in New York harbor in 1906. The dimensions are: length, over all, 407.25 ft., length between perpendiculars 386.5 ft., breadth over all 63 ft., breadth of hull, molded, 50.5 ft., depth of hull, 22 ft., gross tonnage 3721, net tonnage 2312. They have double hulls and numerous water-tight bulk-heads and are the

Every possible provision has been made for the comfort and convenience of the passenger and no expense has been spared in the interior fittings of the vessel which may be best described by the accompanying illustrations. The lighting is entirely by electricity and all rooms are equipped with electric call bells connected to a central annunciator system. A wireless telegraph system enables communication with land at all times.

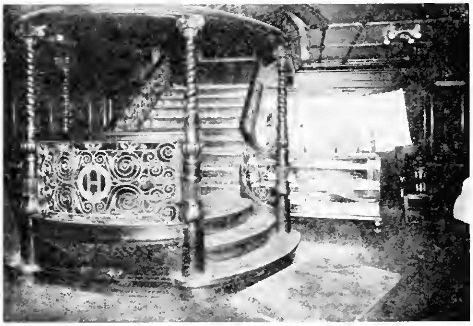
The three-blade triple screws are driven at 480 r.p.m. by Parsons turbines, the high pressure stage driving the central screw and the two low pressure stages driving the other two, governors and automatic



Sketch of Oil Pumping System.



The Dining Saloon.



Courtesy Ocean Travel and Traffic

Grand Stairway Leading from Dining Saloon.

Stateroom With Private Bath, Aboard Yale and Harvard.

Men's Room on Hurricane Deck.

equalizing valves being provided so that the same amount of steam is admitted to the two low pressure stages. Reversing is accomplished by separate turbines placed in the low pressure casings. These turbines are capable of developing 12,000 h.p. and on its trial trip the "Yale" attained a speed of 24.32 knots.

Steam is supplied from a battery of twelve single-ended Scotch boilers, 14 ft. in diameter and 12 ft. long, there being two boiler rooms, separated by a water-tight bulk-head and having three boilers on either side. Each boiler has three corrugated furnaces, 42 inches diameter, leading to separate combustion chambers. The original oil burners were of the Lassoe type, but soon after arriving on the Pacific Coast these were replaced by Staples & Pfeifer burners.

The oil is stored in four tanks in the double-bottom under the boilers, being supplied from the oil-boats through a 6 in. pipe connection. These tanks have a combined capacity of 110,000 gallons, sufficient for a steaming radius of 650 miles. As may be noted from the sketch showing the general arrangement of the oil pumping system, the oil is pumped from the storage tanks to two 3000 gallon settling tanks by means of a 9x5x10 in. duplex Warren suction pump whence a similar pump delivers the oil through a heater and strainer to the main 3 in. supply pipe which branches to each of the 36 burners. The piping is arranged so that the pressure pump can be used as a lift pump or the lift pump used as a pressure pump. There is also an auxiliary 5¼x3½x5 in. pump for port use when only one or two boilers are in service.

The boilers also supply steam for the turbine auxiliaries, the steam steering gear, a large ventilating fan, induced draught and two 50 kw. Sturtevant generating sets with vertical engines. The latter supply direct current at 110 volts for 1600 incandescent lamps, a 24 in. searchlight and a number of small kitchen motors operating a dish washing machine and a knife grinder and buffer.

A KNAVE OR A FOOL.

The following letter of application was received recently by an engineer of a local concern. It is given literally as received, except that, for the present at least, the names of the references are suppressed, and the names of the company addressed and of the author are fictitious:

"Atlantic, Pacific & Gulf Electric Ry. Co.,

"Gentlemen:—

"I desire to make application for employement as an Electrical Engineer with your company. My Qualifactions are as follows,

"Formerly, Engineer of Research, Brown & Biveori, 10 Cross Harper, London, W. C.

"Chief, Design and test room, Current and Pontential Transformers, Westinghouse Elect. & Mfg. Co., Pitsburg, Pa.

"Engineer of record, Detroit United Rys. Detroit, Toledo and Flint systems, Haugensraf, Lief and Haugensraf, (Single Phase System) B 466 Strauser Kiel, Berlin. Unted Manufactures 250 West 54th St., New York.

"University of California,

"University of Chicago,

"Age 35 yrs.

"Native California,

"Salery $4000 to $5000 per year.

"City reference ....

...., ...

"Trusting my application will receive favorable consideration, I am

"Respectfully,

"A. F. RAUD."

Enclosed with the letter was a business card as follows:

A. F. Raud, S B. Ph.D.

The combination of the uniquely illiterate epistle and the letters following the name on the card was so striking that an inquiry was started to ascertain how it was possible for a man to acquire such evidences of proficiency, inferentially along engineering lines, and at the same time to escape rubbing up against the rudiments of his mother tongue.

When the University of California failed to find any record whatever either of his matriculation or of any work he had submitted for his alleged degrees, he was requested to call at the office of the railway company for a personal interview. The conversation was recorded stenographically. He stated that he had entered the University of California with the Class of 1898, had attended the College of Philosophy for two years, and then the College of Engineering for a like period, under Prof. Cory and his assistant; that at the end of this course, in 1898, he had been awarded the degree of B. S. He failed to remember the exact title of his thesis, but in general it was a mathematical dissertation on differentials in transformer design. The thesis was submitted to Profs. Cory and Stringer, (Stringham?)

He stated further that after leaving Berkeley he was in the Westinghouse Electric & Mfg. Company, East Pittsburg works, and that later, after a year or two in Berlin and London, he took up special work in the University of Chicago under Dr. Lichistein (?) for which he was given his Ph.D. in 1902, his thesis being on "The upper and lower magnetics of rotary coverters."

Even with all this detail to guide their search, both the University of California and the University of Chicago, failed to find any record of his triumphal journey through their hands; the latter could not locate the Dr. Lichistein referred to.

Of course it may be that in both these seats of learning their departments of research into records that do not exist may not have been in full working order, but the chances are much more in favor of the hypothesis that his claims to large experience and to advanced educational standing are largely statements of what he would like to have done rather than what he did.

To lie once is easy; to lie persistently, consistently, is beyond even the gods of chance.

NECESSITY FOR VALUATIONS.[1]

BY HORATIO A. FOSTER.

During the last five years the fact that many public utilities corporations, notably street railways, have made only fair earnings, in a great many cases not enough to pay stock dividends or bond interest, has made people careful about putting new money into such properties, and it has been necessary, therefore, to make more careful valuations of such properties in order to insure the success of a new issue of securities.

It may be well right here to give some consideration to the condition of street railway properties and the reasons for the hesitancy of the people to put their money into the securities. Back in the early nineties, when the development of street railways was taking place at a very rapid rate and when promotion of the same was at its height, it was difficult to make company officials realize the fact that depreciation would take place sooner or later, and when their attention was called to the fact the officials and directors, together with the then stockholders, insisted that dividends be paid, and that provision against depreciation be deferred until the future; in fact, the saying was common: "Let the future holders take care of depreciation"; and within the last five years such depreciation has become so manifest in most of the large street railway systems that the officers have had great difficulty in keeping the property in operating order, and within the last two years, owing to the failure of so many roads which were very heavily overcapitalized, it has been extremely difficult to procure new capital for repairs or renewals of the roads, and many have had to go through the hands of receivers. Others have been reorganized, and by careful attention to details have weathered the storm and have come through the ordeal with greater or less success. It may be said, however, that in almost all cases arbitrary arrangements for transfers have so eaten into the earnings that it is no longer profitable to extend the lines or to build new ones in order to prevent congestion of traffic, as they do not bring an adequate income, although adding to the expense of operation.

All these conditions have added to the necessity for valuations and in a great many cases nowadays where the properties have to be re-organized, either through the hands of receivers or otherwise, a valuation of the property, both tangible and intangible, will be found positively necessary in order that the new securities may have a proper basis of issue. For instance, the Public Service Commission, second district of New York State, replied to one application for re-organization to the effect that no re-organization which did not bear some relation to value could ever stand, and that a re-organization in which the present earnings were inadequate to pay interest on the existing bonds was hardly a good foundation upon which to base a further increase of securities.

It is probable that the most notable case of valuation of any public utilities property, and the earliest which created any public interest, was that of the Chicago railways. In this case, the city had, for a long time, been fighting the railways for increased and better facilities, and had gone so far as to declare for municipal ownership, but an agreement was finally reached after many years of quarreling, whereby the railways agreed to go into company with the city, and a valuation of all the physical properties of the company, together with the unexpired franchises, had to be made as a starting point for the combination, in order to form a basis upon which securities could be issued.

Since that time many valuations have been made, notably those of the roads in New York City and Brooklyn, those in Toledo, Cleveland and Detroit, and in all cases both the value reproduced new and the present, or depreciated value, have had to be determined.

It may be said that the appraisal of the physical or intangible property is ordinarily made for one of two reasons; viz.: for sale, or for the adjustment of rates. Where the valuation of the property is made for sale, only the present, or depreciated value, can be accepted, and it is a comparatively easy though rather tedious matter to make a complete inventory of the property and apply present-day prices to the same. It is another question, however, to determine the depreciation upon the property, and that will be treated further in this paper.

As regards the valuation of electric lighting plants, this has only been necessary in case of the properties of a new organization, or for some English syndicate which desired to know the value of the equipment upon which they were taking the securities; and, again, for rate cases where prices have been reduced arbitrarily by some law or ordinance and the companies have been dissatisfied with this reduction and have taken the matter into court.

In modern times, when the subject of a new rate is brought before a court, about the first question asked is: "What property have you upon which you wish to earn a dividend?" and the court pays little, if any, attention to the amount of capitalization upon this property; it therefore becomes necessary for the company to determine this value, both for the tangible and intangible property.

Many valuations of water-works and water-powers have been made in the past, until the methods and rulings have become quite well settled as to most points, so that in the older States, such as New England and New York, the laws covering such valuations have become more or less stable; the points have been determined and technical questions no longer are troublesome.

At the last session of Congress the question of actual physical values of railroads was taken up, and there can be little doubt but that in the near future the determination of such values will be absolutely required in order that the new laws relating to the issuance of securities for railroads may have a proper basis; and furthermore, care must be taken to show all the property, both tangible and intangible, at its proper value. I can, perhaps, do no better than to quote from Mr. Roosevelt's speech on Decoration Day, 1907, at Indianapolis. Mr. Roosevelt said:

"At the outset let it be understood that physical valuation is no panacea; it is no sufficient measurement of a rate; but

[1] Abstract of paper read before Los Angeles Section American Institute of Electrical Engineers, Oct. 25, 1910.

it will be ultimately needed as an essential instrument in administrative supervision. * * * Therefore the physical valuation can never be more than one of many elements to be considered; but it is one element, and at times may be a very important element, when taken in connection with the earning power and business possibilities in reaching an estimate on the property and rights of a corporation as a going concern.

"The effect of such valuation and supervision of securities cannot be retroactive. Existing securities should be tested by the laws in existence at the time of their issue. This nation would not more injure securities which have become an important part of the national wealth than it would consider a proposition to repudiate the public debt. But the public interest requires guaranty against improper multiplication of securities in the future."

A true valuation must not only show the market value today of the physical or tangible property, but different percentages must be added for overhead charges, such as contractors' profit, engineering and superintendence, organization and legal expenses, interest during construction, insurance during construction, contingencies, discount on bonds, and in many cases, a percentage must be added for working capital. All of these (in some cases amounting to at least 25 per cent), must be added to the actual physical values in order to make a correct appraisal of the tangible property of the company.

A complete appraisal, exclusive of the above overhead charges, should show the separate total values for the following:

(A) Cost to reproduce new.

(B) Present value, which means the depreciated value.

(C) Physical development charges.

The above values may be used for:

(A) Rate making.

(B) Sale and transfer of property.

(C) Bond issue.

(D) Total capitalization.

(E) Establishing a uniform system of accounting.

In addition to these it may at times be necessary to make an additional study of values when considering improvements and extensions needed to provide adequate service.

The Cost to Reproduce New.

For this purpose it is necessary to take an itemized inventory of the entire tangible property and apply to each class a unit cost which shall represent the cost of labor and material as of the date at which the inventory is taken. Exceptions should be made, of course, where such unit costs are obviously unfair, due to unusual market conditions or to difficulty of obtaining material such as is in service, but which is no longer manufactured for the purpose. For instance, copper, in the last five years has had a great variation in price, ranging from 13 cents to 27 cents a pound. In the case of electric light companies where extensions have been necessary and they have been compelled to purchase copper at all these prices, it is hardly fair to use the price of today, which may be low, or of tomorrow, which may be high, in determining the value of the commodity which does not depreciate in value as a metal. In such cases it has been customary to take an average price for a number of years, say five.

Each item of the inventory should be considered as reproduced new in the exact form found and the value of the new material of like kind determined. The unit price of all this material should be determined on the basis of a sub-contract in order that the contractor's profit may be added to the total. This profit will ordinarily be ten per cent on all items of a construction nature, but usually should not be added to equipment items, such as the rolling stock in railways, and of course this contractor's profit should not be added to physical development items. Another percentage should be added to cover incidentals, city inspection, organization and engineering—though this percentage does not apply ordinarily, on real estate. A percentage of this sort may be divided into three parts; one-third to cover incidentals, contingencies, incomplete inventories, city inspection, etc.; one-third to cover cost of taxes, organization—such as general office expense, superintendence, etc., and another third to cover cost of engineering.

Present Value.

Present value is determined after consideration of the scrap value, original service value, obsolescence, inadequacy, wear and tear, deferred maintenance and remaining service value. Almost all physical property is worth something as scrap and this value cannot be depreciated; therefore, in determining the present value of any property it is necessary to deduct the scrap value from the value covering reproduction of new in order to determine that portion of the value which is to be depreciated. The scrap value is merely a fair market price less the cost of turning it over to the purchaser. The original service value will be equal to the difference between the cost to reproduce new and the scrap value.

Obsolescence may be described as a decrease in value due to change in the art; such a change as has taken place in steam plants in recent years due to the construction of the steam turbine, which, in many cases, has compelled the abandonment of reciprocating engines long before they had been worn out or become inadequate, simply to save the difference in cost of fuel and labor. Obsolescence can be applied to overhead wires where only the insulation wears out and wires can be added to from time to time, at comparatively low cost. They must, however, be put upon the basis of being compelled, in the near future, to be placed in conduits under ground, in which case the overhead wires must be very much decreased in value, and at times have to be sold for mere scrap. This is one of the most difficult items to determine in connection with an appraisal, and it always results in some arbitrary rate of depreciation being set by the engineer in charge, after long discussion with owners of the property and with their engineers. The application of this rate to the elapsed life of the original service value last mentioned equals the deduction to be made for obsolescence. Where there are parts which are already obsolete, of course only salvage values should be allowed.

Inadequacy applies particularly to street railways in which tracks have to be torn up and sold for second hand or for scrap owing to the fact that the rails are no longer heavy enough to support the cars which have been bought to replace the smaller cars which are no longer adequate and for which the public loudly demands a substitution. There are probably few things in which substitution has gone on more rapidly than it has in the street railway business; in fact, one of the items calling for a decision by the Supreme Court and by many commissions is, what value shall be given to expenditures for property which has entirely disappeared. For instance, in the early days of electric railroad installation, the purchase of the horse railway meant simply the purchase of the right to build an electric line, for in no case was the track heavy enough for electric cars, nor was it of proper construction; the car barns were only good for storage of a few empty cars, and never large enough for the newly developed property. The horse barns were abandoned or used for storage purposes only, and the horses were sold for what they would bring, leaving nothing but the right of way in the street, over which rails could be laid by the new company; thus at a stroke, the value of the first property disappeared. An important question is: "Should value be given to the property which was purchased and thrown away, and if so, what amortization of that property should be charged off, so that in time, after proper re-organization, the stock or securities issued would equal only the value of the new property which was and is in existence?"

Wear and Tear of any part is the normal deterioration of that part due to service, the action of the elements and accidents. This must be offset eventually by the regular repairs. A depreciated condition of the whole property will always exist from this cause, due to the fact that wear and tear on the system as a whole occurs gradually and continuously, and will be offset gradually, and not all at the same time. It is obvious that the cost of renewals and repairs should be charged to operation. The amount to be allowed for wear and tear can be arrived at upon the basis of a percentage of the original service value on such class of construction, never in excess of fifty per cent, but it must be determined in each case by the ratio which the average age of the several units comprising the class of material in question, exclusive of replacements, bears to the estimated total life of this class of materials, when subjected to wear and tear only, always assuming the highest practicable maintenance. It may be assumed that the life of no class of materials will exceed one hundred years. This rule, of course, must not be applied to individual pieces of apparatus, but where many such pieces exist in the system, this so-called fifty per cent rule may be applied with much satisfaction.

Deferred maintenance results from neglecting all proper and regular renewals and repairs, and is, of course, measured by the expense necessary to offset such neglect. This expense should be charged to operation. The estimated cost of deferred maintenance on any part may be obtained by arriving at the expenditures necessary to bring that part up to good serviceability.

The remaining service value is found by subtracting the sum of obsolescence, inadequacy, wear and tear and deferred maintenance from the original service value, and the present value of the property is then equal to the scrap value plus the remaining service value.

Physical Development Charges: In the production of a property there may be certain expenditures required in its development apart from those clearly evidenced by the finished property, some of which should be wholly included in the cost to reproduce; others should be partly included, and still others should not appear at all, as they must be taken care of previously by amortization. These rules of expenditures may be described as follows:

Class A. Items, the total cost of which should be added to the cost to reproduce and upon which a definite estimate of cost can be made.

Class B. Items upon which only an approximate cost can be determined, or in regard to which the propriety of their addition to cost to reproduce may be questioned.

Class C. Items of such intangible nature, indeterminate value, improper expenditure or so antiquated as to prevent their addition to the cost to reproduce.

Now, a word upon the **going value** or **good will** of a corporation.

The Maine court has ruled that the "going concern" or "established business" is an element of structure value. It may be defined as the cost of establishing, up to the level of the net income of the old plant at the date of taking, the business of a similar new plant (but not of a more perfect system which the city might build), which is supposed to begin operation upon the date of the taking, the old plant going out of business at the same moment. Or, to put the same thing in another way, it is the measure of the greater value (at the date of taking) of an old established plant, over a similar new plant completed and ready for operation upon the date of taking. Or, to put the same thing in still another way, it is the measure of the cost of developing the business of a new plant to a point coincident with the net income upon the date of taking, of the old plant.

With the exception of a few cases which recently have been passed upon by the Wisconsin Commission, few electric light or electric railway cases have been decided in which a value has been set upon the good will or going value. It is obvious that the going value may exist even after the franchise has expired, if the plant continues operation and continues to serve the community. This value was recognized by Justice Brewer in the decision of the Supreme Court of the United States in the Kansas City Water Works case. The following is the language used:

"The city steps into possession of a property which not only has the ability to earn, but is in fact earning. It should pay, therefore, not merely the value of a system which might be made to earn, but that of a system which does earn."

It is seldom, however, that any two or more indi-

viduals agree upon the method of determining the going value or good will of a concern upon which an appraisal has been made. A recent compilation of twenty appraisals shows a variation in the value of the good will of 0 to 47 per cent of the value of the physical property of the plants. In fact, in an important recent appraisal, of the five leading specialists making the appraisal, no two agreed upon the method of computing the value of the good will.

In the purchase of properties of various companies by English syndicates, their method for determining the value of the good will is to take the value of the net earnings of the corporation under consideration for one, two or three years, as a measure of the value of good will. A greater amount than the income for three years has, in some cases, been taken; in fact, the writer knows of one case where a valuable business was purchased and where five years' net income was taken as the value of the good will.

Reference has been made to some of the decisions of the Wisconsin Railroad Commission, and it may be well to quote one or two of them:

In the Cashton Light & Power Co. case: "The element of "going value" created by the investments made in developing the business and in addition to the cost of the physical structure must be taken into consideration in fixing value; although the franchise of a public utility operating under an indeterminate permit has expired upon the exercise by the municipality of its option to purchase, the plant is to be taken over as a going concern; and just compensation must be awarded for the property taken as a living and operating entity, engaged in serving the public, and not as a mere plant without patrons and without privilege or right to operate and to serve the public and having but a salvage value."

Also, in the Antigo Water and the Marinette Telephone cases: "The theory of the Wisconsin pubilc utilities law is that rates shall be reasonable and shall be not greater than enough to yield a fair return on the investment. In determining the investment as a preliminary process to the fixing of rates, the commission had to deal with the claims of large "intangible" franchise values as well as "going values" in both the Antigo water case and the Marinette telephone case. Regarding the former, the commission holds that if the municipality required the payment of money or its equivalent, or there was necessary ligitimate payment made for the franchise, then the sum which may be reasonably said to have been paid for the franchise may be included in the valuation, the same as money necessarily invested in physical property. But the Commission refuses to consider the claims of some experts and corporations that franchises for which no money was paid may have "intangible" values which should be considered in the making of rates.

"It has been held by experts that "going value" should be allowed as so much per customer, or as a percentage of the receipts, and some have considered it of as great, if not greater, importance than the physical value of the plant. The Commission holds that the actual reasonably wise expenditure of money towards getting the business of the plant established may be included in the value to be allowed for the purpose of fixing rates. Since no plant pays at the outset, and the first years of operation are almost invariably accompanied by losses or necessary deficits, the Commission holds that such losses may be said to represent the cost of securing an established or going business, and as such may be included in the value or investment upon which the rates for public service shall be fixed. But the converse of the rule also holds, that is, if a plant has in the past earned more than a reasonable return, possibly through the toleration of excessive rates, the excess over reasonable earnings may, under certain conditions, be substracted in determining the present value of the plant. That is, a "going value" may be negative. In the case of the Marinette Telephone Company, for example, the Commission found upon its investigation of the financial history of the company that through a period of recent years the company had been enjoying a sufficiently high rate of return to write off the early deficits in so far as such deficits might be allowed as going value."

The method used by the Wisconsin Railroad Commission in determining the going value of gas and electric light plant in the case of the State Journal Printing Co., et al. vs. the Madison Gas & Electric Co., was as follows:

Beginning twelve years back; to the then earning value of the company was added, all additions to depreciable property, the increase in land values, depreciation at four per cent on the sinking fund basis, and interest at seven and a half per cent on the value; net earnings from operation for that year, giving a new value which was used as the earning value for the succeeding year. This process was carried on each year for twelve years, adding all the items mentioned above and subtracting the net income at the end of each year, thus arriving finally at a much increased value, which was called by the Commission the earning value of the plant at the end of the time for which the computation was made.

The writer has not as yet gone into the merits of this method, but all of the decisions of the Wisconsin Railroad Commission have been so fair as to receive the commendation of all parties concerned in them, and the commendation of engineers and appraisers in general; in fact it may be said that the decisions of this Commission have received more public commendation than those of any other Commission of recent years.

Franchise Values.

This is one of the most troublesome questions that comes before the appraiser and the values have been determined in a number of different ways. Perhaps that made use of by the Ford Franchise Commission in New York State has been carried the farthest. In this case an appraisal is made of the physical property of the company and to this is added the capitalization of the net earnings of the company, such capitalization being made at 2, 3, 4 and 5 per cent, according to the class of the city; this total is then called the assessed value of the franchise which is taxed, and it is this method which has been fought so long and hard by all public utilities corporations in New York State, and which has, in every case, been sustained by the courts, clear up to and including the Supreme Court of the United States, and the companies have had to compromise or pay according to this assessment. This, perhaps, is the best evidence existing to show a method of valuing a franchise.

Another method—that used in appraising the value of the franchises of the Chicago street railways—is to deduct from the gross receipts the usual operating expenses, including taxes, maintenance and renewals, which leaves the net receipts from operation; from this net is deducted interest at the current rate—say five or six per cent, which must include brokerage—on the capital; the remainder will represent the franchise value for one year. This value can be determined for a term of years by obtaining the present

value, or estimated future yearly franchise values, taking into account an estimated rate of increase of business.

Depreciation.

I shall begin this subject by quoting from two authorities; one the Supreme Court of the United States, and the other Professor Cooley, of the University of Michigan. The Supreme Court of the United States, in a decision rendered in the Knoxville water case, has the following to say:

"A water plant, with all its additions, begins to depreciate in value from the moment of its use. Before coming to the question of profits at all the company is entitled to earn a sufficient sum annually to provide not only for current repairs, but for making good the depreciation and replacing the parts of the property when they come to the end of their life. The company is not bound to see its property gradually waste without making provision out of earnings for its replacement. It is entitled to see that from earnings the value of the property invested is kept unimpaired so that at the end of any given term of years the original investment remains as it was at the beginning. It is not only the right of the company to make such a provision, but it is its duty to its bond and stockholders, and, in the case of a public-service corporation at least, its plain duty to the public. If a different course were pursued the only method of providing for replacement of property which has ceased to be useful would be the investment of new capital and the issue of new bonds or stocks. This course would lead to a constantly increasing variance between present value and bond and stock capitalization, a tendency which would inevitably lead to disaster either to the stockholders or to the public, or both. If, however, a company fails to perform this plain duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over-issues of securities, or of omission to exact prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors of management which have been committed in the past."

The elements of depreciation are admirably stated by Professor Cooley, as follows:

"1. Depreciation Due to Wear and Tear and Exposure to the Elements.—This is continuous. All elements have a wearing life varying with the element itself. No element can be completely worn out; it can be worn only to a point below which it becomes unsafe or no longer serves its original function. In practice the average condition of all elements must be maintained at a high percentage of the original cost if the property is to serve its purpose properly. This percentage varies from 75 per cent to 85 per cent of the cost now of the property. The difference between this percentage of from 75 to 85 and the original 100 is a depreciation which is inherent in the property and cannot be dispensed with. It must be met by a sinking fund, or its equivalent, otherwise this part of the original investment becomes lost.

"2. Depreciation due to Accidents, a Sudden Depreciation.—An engine or a boiler may be wrecked and with it other machinery. This might, and probably would, involve a considerable expense for repairs or replacement, besides possibly crippling the plant in part. Cars may collide or a car may drop through a bridge. A bridge itself may fall or be carried away by floods. A storm, as a cyclone, may work havoc, entailing costs in excess of those proper to be charged to ordinary maintenance of property.

"3. Depreciation Due to Inadequacy.—Cars suitable in the past had already been superseded several times by larger and better cars. This has rendered the track, structure and bridges inadequate, and as more power is required to propel the larger cars, the power plants have become inadequate. The public demand is largely responsible for this depreciation due to inadequacy.

"4. Depreciation Due to Obsolescence.—This, while closely allied to the depreciation due to inadequacy, is different in that it embraces changes due to advance in the art. More efficient and effective machinery has appeared, which must be substituted for the old to keep abreast of the times. For example, in steam engine practice the turbine has come into general use during the past five years and the art of steam turbines is at the beginning. Generators adapted to piston engine practice are not adapted to steam turbine practice and must also be changed. Boilers adapted to piston engine practice must be replaced to carry the higher pressure required. Condensers must also be changed to secure the better vacuum required to realize the full advantage of the steam turbine. Owing to the rapid disappearance of coal beds, the price of fuel must advance, and this presumably will, before many years, force the adoption of the gas-producer and the producer-gas engine. Water-powers are wisely being developed, but to utilize them requires the scrapping of large parts of the machinery in use at present."

In few cases do the parties in interest agree upon the amount or rate of depreciation to be charged upon different portions of property; in fact, in any group of engineers who are asked to set rates of depreciation upon various items or classes of items, it will be found that scarcely two of them will, in the same case, set the same rates of depreciation, and this can hardly be wondered at for the reason that circumstances enter so largely, for instance: Steam engines which, in the past, have lasted 25 to 30 or 40 years, are now cast out, owing to the invention of the steam turbine. Buildings which, under ordinary circumstances will easily last one hundred years, and for any ordinary purposes would last that length of time, become inadequate for ordinary business, and have to be replaced in 15 or 20 years by new and larger buildings of more modern construction.

Going a little way from our subject and applying this to large buildings in New York City, the instance of the Plaza Hotel is perhaps one of the best in which a first class, modern hotel, of large size and splendid equipment, located at the corner of Fifty-ninth street and Fifth avenue, was torn down and replaced by a much larger and modern building, after a life of only 18 or 20 years, because it was found that the new structure would not only pay the interest on its own cost and the increased cost of the ground, but upon the cost of the purchase of the old building itself. Many other instances can be given of this, and yet, how would the rate of depreciation have been determined upon this very building ten years ago?

Coming back nearer to our own subject, the depreciation upon overhead copper wires will demand serious consideration in almost all of the larger communities, for the reason that as the city progresses, and demands more and better service, it also demands that the wires in congested districts be placed underground. These wires may have only been in place for ten or fifteen years although it is well known that copper itself will last for indefinite periods, and only the insulation deteriorates.

The old style arc lamps, which were good enough fifteen years ago have, in the last ten years, been en-

tirely superseded by the modern enclosed arc, which is now being superseded by the magnetite type of lamp.

In the case of transformers, ten or fifteen years ago only the smaller types were in evidence, while today the large sizes are more frequently put into use, and whole districts are lighted from centers of distribution, rather than from individual transformers. What rate of depreciation is to be put upon the value of transformers of the smaller and older types?

There are several methods of applying rates of depreciation:

(A) The Straight Line Method.

(B) The Sinking Fund Method.

(C) The method of a flat percentage chargeable each year against the value of the plant.

The first, or straight line method, is merely the charging off each year of a certain stated amount, which is the proportion of first cost, determined by the years of life arbitrarily set upon that part of the plant, against which the depreciation is charged.

The second, or sinking fund method, is the setting aside, at interest, an amount which, at the end of the term of life set upon the plant, will equal the total value of that part of the plant depreciated.

The third method is to charge against the value of the plant at the end of the year a certain percentage, which has been settled upon by the owners, and which can be charged for many years without reducing the value of the plant to zero.

EXCHANGE OF NEW BUSINESS IDEAS.

There is now in active operation from coast to coast, a thoroughly working exchange system of advertising and publicity between the large electric companies of the United States and Canada. This exchange was brought into being about the first of the year through the efforts of Mr. F. D. Beardslee, commercial engineer for the United Electric Light & Power Company of St. Louis, Mo.

Mr. Beardslee's idea is to put some twenty or more of the largest central stations of the continent in automatic communication with each other in regard to the publicity campaigns which they are carrying on in their respective territories.

The list at present includes fourteen of the largest companies. Its working, as arranged by Mr. Beardslee, is as follows: The man in charge of the advertising of the company mails a duplicate copy of every new piece of publicity, including all new advertising matter used by him in newspapers, magazines, pamphlets, novelties and follow-up letters, to each of the other members of the exchange. In this way each company has the benefit of every idea originated by every other company in the exchange. The system is working successfully and that it will probably grow to include many more members. At present those who represent the fourteen companies in the exchange list are:

Mr. E. W. Lloyd, general contract agent, Commonwealth Edison Co., Chicago, Ill.; Mr. Howard K Mohr, advertising manager, Philadelphia Electric Co., Philadelphia, Pa.; Mr. T. I. Jones, general sales agent, Edison Electric Illuminating Co., Brooklyn, N. Y.; Mr. L. D. Gibbs, advertising manager, Edison Electric Illuminating Co., Boston, Mass.; Mr. Jos. P. MacSweeney, assistant commercial agent, Rochester Railway & Light Co., Rochester, N. Y.; Mr. C. H. Peirson, advertising agent, Southern California Edison Co., Los Angeles, Cal.; Mr. John O'Toole, publicity department, Public Service Corporation of New Jersey, Newark, N. J.; Mr. J. E. McKirdy, advertising manager, The Alleghany County Light Co., Pittsburg, Pa.; Mr. C. N. Duffy, general sales agent, Milwaukee Electric Railway & Light Co., Milwaukee; Mr. M. J. Connely, advertising manager, Denver Gas & Electric Co., Colo.; Mr. B. C. McNabb, New Business Dept., Montreal Light, Heat & Power Co., Montreal, Canada; Mr. H. J. Gille, commercial agent, Minneapolis General Electric Co., Minneapolis, Minn.; Mr. George Williams, care Messrs. Henry L. Doherty & Co., 60 Wall street, New York City; Mr. F. D. Beardslee, commercial engineer, Union Light & Power Co., Twelfth and Locust streets, St. Louis, Mo.

ORGANIZATION AND DISCIPLINE.[1]

BY M. C. RORTY

I will try to give you an outline of the general principles of organization and discipline, together with some notions as to detailed methods of handling men. Let me begin by drawing a parallel between the development and handling of an organization and the design and operation of a steam engine.

In the case of the engine, the designer who made the plans would provide a cylinder and piston rod and cross-head and a connecting rod and crank. He would select the material for each with an eye to its special qualities, and would give each part dimensions proportionate to the demands to be made upon it. He would also give each part special functions, and would define in his own mind, down to the smallest detail, the duty that each should perform in the operation of the engine as a whole. He would never throw a tangle of material together, and turn steam into it, in the hope that it would grow into an engine.

And when the engine was completed and turned over to the engineer to run, (this in my parallel, representing the change from the development to the routine handling of an organization), the engineer would not say, if a bearing began to squeak and grow hot, "Good bearings do not squeak," for he would know that it was the nature of bearings to squeak, but would set to work at once with wrench and oil can until things ran smoothly again. He would know, too, that the more power the engine was developing, and the harder piston rod pushed against cross-head, and cross-head against connecting rod, and connecting rod against crank, the more chance there would be for friction. But he would not, for that reason, shut off steam. He would realize that if quiet and rest were all that were wanted, a turn of the throttle would secure that.

And if, in some way, the piston rod should begin to grow, and should say, perhaps, that the connecting rod was weak and that it would be better for the piston

[1] Abstract of paper read at the University of Wisconsin, Madison, Wisconsin, and printed in the Wisconsin Engineer.

rod to take hold of the crank directly, the engineer would not say, "Very well, fight it out." He would know that that would probably result in injuring or wrecking the machine. As a sensible engineer, he would say, more probably, "Very well, that may be so, but the designer and I will have to consider the question before any change is made. In the meantime, remember that you are still only the piston rod." And if the piston rod did not take the hint, he would find a new piston rod that believed in organization, and that he could safely trust alone with the rest of the machine. He would do this even if he believed that the connecting rod was weak and was not required in the engine.

Leaving this parallel as it stands, let me next state briefly certain fundamental principles of organization and discipline.

These are:

1. Each position in an organization should have assigned to it definite responsibilities and definite authority. These may, and, in most cases, should be reduced to writing.

2. Active responsibility should always be coupled with corresponding authority.

3. No change should be made in the scope or responsibilities of a position without a definite understanding to that effect on the part of all persons concerned.

4. No dispute as to the authority or responsibilities of a position should be considered too trivial for careful adjudication. The knowledge that this adjudication can always be obtained will tend to reduce friction and to promote amicable adjustments of differences.

5. An official in charge of any work, whether competent or incompetent, must insist upon his decisions as to methods of handling work being respected and followed out by his subordinates. A good man will give all possible weight to the opinions of his subordinates and, as he gains confidence in their judgment, will leave many points entirely to their decision. He will thus retain good men in his service. A poor man, on the other hand, will decide arbitrarily and will not delegate definite responsibility to his subordinates. He will, therefore, be unable to retain good men in such positions.

6. The work should create the position rather than the reverse. When questions of personnel make arbitrary divisions of responsibility necessary, unusual care must be taken accurately to define the limits of authority.

7. A sure appeal to men for extra exertion can only be made on the basis of their self-interest. To this end the organization should make full provision for filling, from its own ranks, any vacancies that may occur. The security of position which a good organization gives to its officials makes them ready and willing to give their subordinates full information of a kind to fit them for advancement.

Appeals to the loyalty of subordinates to superiors, or to "stockholders," will soon prove futile if accompanied by no prospects of advancement or increased remuneration.

8. The most certain guarantee of a loyal and enthusiastic working force is the adoption of a definite and logical policy, consistently carried out. The opportunist may occasionally achieve success for himself but he acquires few followers.

The principles that I have just enumerated apply equally well to all organizations without regard to the nature of the work involved, whether this be the making of steel rails, the selling of groceries, or the maintenance and operation of telephones. When, however, we come to study the characteristics of particular organizations we find that, in addition to these general principles, there are many other special factors to be considered. Among these might be named the geographical distribution of the working forces, the possibility of minute subdivision and specialization of the fundamental work of the organization, the presence or absence of broad natural lines of cleavage extending throughout the work of the organization, the character and extent of facilities for transportation and communication, the necessity or absence of necessity for local one-man authority, etc.

Leaving now the broader problems of organization, I will try to give you a few points as to detailed methods of handling men.

In the first place you have all heard of the old recipe for cooking a rabbit, in which it is specified that you must first catch your rabbit. So in handling men you must first learn to hire them.

Now I firmly believe that experimental psychology in time will develop to a point where it will be of definite value in selecting men for particular lines of work, and incidentally in determining courses of school and college instruction for individual students, but during your time as executives it will, I imagine, be necessary as today, to rely for such purposes largely upon the cruder psychological processes of personal judgment.

In my own selection of men, I first consider the work I have in mind and, if possible, choose a man who, while specially qualified for the particular work in view, is of so well balanced a make-up that he can, if necessary, be shifted to other work. This is important even in large organizations, and is doubly important where only a few men are employed.

In the second place, I am as careful not to pick too intelligent a man for a job as I am to secure a man that is intelligent enough, and, in determining this point, it is necessary, particularly in hiring young and ambitious men, to know with a fair degree of accuracy what, and how many, lines of advancement are open in the organization. As a general rule, the men you employ will have a rather fair minded view of their own capabilities, and of what is a proper rate of advancement, and you will secure best results by having neither a surplus nor a deficit of talent. I sometimes think that it is better, on the whole, occasionally to be forced to advance a man to a position a little beyond his natural capacity, than regularly to have an excess of highly intelligent men working in low grade positions.

And finally I never, when I can avoid it, rely entirely upon my own judgment either in hiring or in promoting a man. I have found, and you will find, that every man, consciously or uncon-

sciously, measures his intelligence against the intelligence of those with whom he is thrown in contact, and he does not do this fairly, point by point, but chooses his own strongest points as the basis of comparison. This principle is exactly the same as in trials of muscular strength, where the one proposing a test selects always some trick in which he is particularly skillful. So, in selecting an employe, I have him judged, whenever I can, by a number of persons of known and varied mental characteristics, and from their combined opinions find it possible, in the majority of cases, to make up a very accurate analysis of the man under consideration.

The determination of mental characteristics is, however, only a part of the proposition. I am inclined to think that my first instinctive measure of a man is based upon his appearance of health or ill health, and that I make judgment next for general normality or abnormality of makeup, and finally look for facial and other outward signs of perseverance and good tempered firmness, which are positive qualities and signs of strength, as distinguished from obstinacy which is a purely negative quality and a sign of weakness. And, unless an applicant measures up satisfactorily as to the points I have mentioned, I do not concern myself at all with the absolute degree of his intelligence.

With the proper man hired for a job and with the job properly laid out, two-thirds of the work is done, and the balance is simply a question of proper handling and discipline.

I specified near the beginning of this talk certain general principles for the handling of an organization and will supplement those principles now by describing more detailed and more personal methods of securing results.

To start with, there are as many kinds of men as there are of horses and, just as different horses require different handling, so the skillful driver of men will vary his touch for each individual. However, in all cases, you can make no mistake by keeping the personal interests of your subordinates in mind fully as much as your own, and, when you find your interests in conflict with the best interests of an employe, you will do well in the majority of instances to give precedence to his interests, and to secure your returns in the long run from the loyalty to you on the part of your subordinates that will follow the consistent carrying out of this policy. You must also treat your own authority as a thing so well established that you can afford to ignore minor breaches of discipline and to bear patiently with the augumentative man. Yet, on the other hand, when the time comes that the needs of your work call for definite and decisive action, and you have given all possible consideration to the suggestions and opinions of your subordinates, you must be prepared to enforce your decisions to the letter and without mercy to the obstruction. In such cases do not make the mistake of saying that you personally require certain things to be done, but say, rather, that the work requires certain action and that you, as the appointed agent of the work, will fire every last man on the job if necessary to get results. And in all your talk with your subordinates speak everlastingly of what the work requires and scarcely at all of what you personally desire.

In dealing with intelligent and sensitive men you must be an allopath in encouragement, instruction and judicious praise, and a homeopath in criticism. With unintelligent and shiftless employes, on the other hand, you must combine with these a wholesome fear of consequences, while to both types of workers you can apply, perhaps better than anything else, the stimulus of comparative figures as to results.

Now what I have told you may seem cold blooded and brutal, and it would be so, except for the fact that, when you have once demonstrated your entire willingness to perform a surgical operation on a crowd, if required for the cure of diseases of discipline, you will find that they will respond promptly to milder remedies. And, when you have brought this condition about and have tuned your organization up to concert pitch, you will be in the fortunate position where before removing a man, you can safely wait until his own associates are firmly convinced of his unfitness. Furthermore, by the judicious use of pace makers and comparative figures, you can readily develop a speed that will cause the majority of the unfit among your forces to drop out of their own accord into positions more nearly suited to their natural capacity.

I have told you now something of business organization and something of the ways in which men may be handled, but I have said nothing of what, to you as individuals, is a greater problem—the problem of self-development and self-handling. The average university graduate, when he begins his college course, has a productive value of perhaps $7 to $8 per week, and when his course is ended this value may have increased to $12 or $15 per week. In four years, therefore, the increase has been at the rate of less than $2 per week per year. Yet during the following twenty years of practical day by day experience, this increase for the ordinarily successful college man may continue at the rate of from $3 to $5 per week per year. This fact can in plain terms mean only that the effective man, each year after leaving college, learns more of productive value than he learns during the corresponding years of his college course. So when your time for graduation comes, do not think that your student days are over. You are simply changing schools and school-masters, and the peculiarity of Prof. Hard Experience, who will be your chief instructor, is that he teaches not so much what to do, as what not to do—and teaches the latter with a club.

To know what the college man should study after graduation, particularly if he hopes in time to take up executive work, it is necessary to know his special weaknesses. In respect to these I am quoting not only from my own experience, but from the experience of many others, when I say that the recent graduate is of an over-analytical turn of mind, has too much confidence in the goodness and honesty of human nature, and in general lacks absolutely the ability to see all sides of a proposition and to drive things to a conclusion without the turning of unnecessary corners.

These faults are in part the natural faults of youth and inexperience, but, to a greater extent, are due directly to certain perhaps unavoidable peculiarities of college training, and it is in one way not entirely fair to describe them as faults, for they continue as faults after graduation only when untempered by proper

observation and study. Nevertheless, it is a frequent and thoroughly distressing experience, when assigning a recent graduate to a definite line of work, to have him seize upon some comparatively insignificant feature of the job and analyze it to death, while at the same time, neglecting utterly a dozen more important features.

The college man, first of all, needs perspective and breadth of view, and, following that, needs a knowledge of men, and, to become strong in both of these directions, it is necessary, not only that he shall study his job from the bottom up by personal experience in his daily work, but that he shall also study it from the top down by reading and by taking every opportunity to talk of the work with those who are in position to see the broader aspects of it. Also, in studying men, it is necessary for him to know and study not only the men with whom he is thrown in daily contact in his work, but also to meet and know the men who are what he hopes some day to be. It is, of course, impossible, in a large organization, for the higher officials to meet and know all or even a large proportion of the subordinate employes, but, in the various engineering societies and business associations that the college graduate may readily join, he will find, if not his own superior officers, at least men occupying positions of equal responsibility, from whom, if he goes about it in the right way, he can readily obtain invaluable information and often direct personal advice. In his own line of work, too, he will ordinarily be surprised to find how willing his superiors are to give him a chance to become acquainted with branches of the work other than those in which he is directly employed. Requests for opportunity to acquire such information may occasionally be refused, but I doubt if in one case in a thousand they will ever be resented.

In addition to the information that may be obtained in this manner, it is important that the college graduate shall avoid the reaction from the reading of books that seems, in ninety-nine cases out of one hundred, to follow the completion of a college course. In this I refer not alone to a failure to read books applying to the particular line of work in which the graduate is engaged, but more particularly to a failure to read those books that are of assistance in knowing men. The man who hopes to become an executive and to handle business problems, must, above all things, know the nature of mankind in general, and I believe that this knowledge can best be secured by a proper proportioning of time between the direct study of men and the indirect study of them through books.

In all that you have studied here at Madison, and in all that I have said to you so far today, the most obvious point in view has been the securing of material dollars-and-cents success. Yet I might quote both Huxley and the "Declaration of Independence" to you to show that this material success is but a means to an end, which end is the securing of a rational happiness for yourselves and your neighbors. And, in analyzing the means whereby this rational happiness may be arrived at, you will find that it is expressed by the product of your co-efficient of appreciation of the sanely good things of life, into your opportunities for the enjoyment of them. And you will find, too, that happiness is as contagious as melancholy, and that your opportunities for the sane enjoyment of life are measured mainly by the friends you make, and the leisure time you have, and in least part by the money you have to spend. So, if you arrive at a sane philosophy of life, you will recognize that, if your co-efficient of appreciation is zero, and if your friends are zero, and your leisure time is zero, the value of your life, as a whole, will likewise be zero, whether you multiply the preceding factors by tens of dollars or by millions of dollars.

And this question of ideals is not an academic one, even from a purely business standpoint, for I have repeatedly heard men in responsible executive positions say that, in selecting a man for important work, they always felt safer if they knew that he had fixed and sane views of his purpose in life, and that they distrusted men, however capable, who looked upon their work solely as a means for personal advancement, and had none of the artist's satisfaction in good work for its own sake well done.

Now, I have, perhaps, taken an unfair advantage of you by talking of the philosophy of life, after giving my paper the business like title of "Organization and Discipline," so I will conclude and, at the same time, will try to square accounts by turning over to you a ready made philosophy from Marcus Aurelius, who says—"Besides you will quickly go the way of all flesh. * * * Therefore, what ever the dignity of human nature requires of you, set about it at once, without 'ifs' or 'ands,' and speak always according to your conscience, but let it be done in the terms of good nature and modesty and sincerity."

Examination for electrician is announced by the United States Civil Service Commission on March 8, 1911, for the position of electrician in the Bureau of Standards at $900 per annum. For filling the position it is desired to secure a competent electrician qualified in the care, maintenance, and repair of station storage batteries, and skilled in "lead burning" as applied to such batteries. The Bureau has in connection with its electrical equipment 800 storage batteries, and mere experience with automatic batteries is not considered sufficient for the position. It is also desirable that the appointee shall have had experience as an interior wireman, in addition to having a good general knowledge of electrical work.

PRESERVATION OF WOODEN TIES.

There are now more than 70 wood-preserving plants in the United States. A number of the large steam roads possess expensive plants fitted to handle large quantities of timber in a very efficient manner. Nearly all treated cross-ties used by steam railroads are treated in closed cylinders permitting the application of pressure and designed to secure a heavy absorption of the preservative. The principal preservatives used were creosote oil, and, to an almost equal degree, a solution of zinc chloride. Many ties are treated with an emulsion of creosote oil and a solution of zinc chloride, and one road treated large quantities of its ties with a heavy injection of crude petroleum.

CORONA.

Discussion of paper abstracted by Professor H. J. Ryan before the San Francisco Section of the American Institute of Electrical Engineers, January 27, 1911:

B. C. Schipman: Professor Ryan stated that in an alternating circuit the ions were carried to and fro, and that the general tendency was towards the conductor, and that therefore there was a general total movement of the atoms that way. Wouldn't that also be true of a direct current? Then, if you had a high tension direct current wouldn't there be a gradual transfer as in electrolysis?

Professor Ryan: Yes. I probably should have been a little more explicit in touching on that matter, in calling your attention to the inherent difference in this connection between the continuous electric field and the alternating electric field. These fields have exactly the same figure or form. In the continuous field therefore naturally an ion, that is, the electrofied particle of gas, say a positive ion, will travel through the field and ultimately will reach the negative conductor. The negative ion will ultimately in the same way reach the positive conductor because there is no reversal of the electric field. If the negative ion happened to be near the negative conductor when the voltage was turned on it would have to travel at first through a tube of force that would be enlarging; being near the conductor, the tube is narrow there, and it enlarges as it extends from the conductor. As the ion approaches the positive conductor the tube of force of the electric field in which it is moving is contracting. In the alternating current case there isn't time between the alternations for the ions to make the whole travel. Some of them can—those that happen to be near the oppositely charged conductor; but others will not; the distance is too great, and they only get across part way. Now, if in traveling in the direction of a concentrating field they travel no farther than they travel in the opposite direction they would oscillate back and forth in place, and they would never arrive at either conductor. It is known however that they all move up in an alternating field, by degrees at least, and concentrate around the conductor, and there they move back and forth. Probably they strike the conductor at the time it is at maximum voltage, reverse sign and are driven out again through the remaining half of the alternation; but we haven't much evidence or data as to the exact mechanism of this phenomenon. We all know that it is so in effect. It is surprising at first that the stock of ions should accumulate about the conductor, and are shuttled in that way back and forth in its neighborhood. We have the fact to begin with, and it must be caused by the ions making a greater journey through a given electric field in the direction in which it is contracting than in which it is expanding. It is a fact that high tension wires operating with alternating pressure do concentrate a stock of ions about them. That causes one to see that they must travel further at each alternation when they are going in the direction of the concentrating field. You can see that it is a matter of velocities, resistances and details of that sort. I believe that those who work on the kinetic theory of gases could account for the phenomenon.

W. A. Hillebrand: At the White Mountains Convention (July 1, 1910), Dr. Kennelly in discussing Dr. Whitehead's paper, called attention to the very fact that Mr. Ryan has just mentioned, the fact that a charged particle may tend to move with an increasing velocity towards a converging field. And I would say, in addition, that he merely called attention to that likely fact at the time, and also raised a query, that is, he wanted to know whether or not this would play some part in the corona phenomena that had been observed.

Professor Ryan: To my mind, then, Dr. Kennelly has already anticipated the real cause of the concentration of a stock of electrified air about the conductors of an alternating high potential transmission line.

A. J. Bowie: Has the velocity of the wind had any effect on the sub-corona losses?

Professor Ryan: I have no direct evidence as to that. That is one of the interesting things to study in connection with corona and sub-corona atmospheric losses. I do not know. I was not able to come across any definite evidence in connection with that point anywhere, and I have no reasonable basis of conjecture as to what the effect of wind to a moderate extent would be.

B. B. Beckett: What relation has the diameter of the conductor to these convection current losses? I believe the smaller the wire the lower would be the voltage. It has been rather encouraging in considering the possibility of transmitting at some future day very heavy loads to long distances and using very large diameters and very high voltages. It looks now as if we were going to get into another difficulty, because, if I understand it correctly, this convection current would be greater in the large conductor than in a small one. Is that right?

Professor Ryan: I am glad you bring up that point. I should have spoken of it. The evidence is quite clear that the convection current loss depends largely upon the stock of ions that can be accumulated in the neighborhood of the conductor; there is some evidence that this stock is increased somewhat by the size of the conductor, and the intensity of the electric field about it. Loss by corona may be avoided by increase in the size of the conductors; loss by convection cannot be eliminated by the same expedient. Such convection loss becoming serious at high altitudes and high voltages, may undoubtedly be greatly reduced by lowering the frequency where that is practicable, otherwise the voltage must be limited to the economy value whereat the higher costs of operating at the lower voltage are fully compensated for by the convection current loss thus avoided. Indeed, it would be all the better if the direct current could be employed as some advocate in Europe, but I realize that this is looked upon as an academic proposition in our country.

C. F. Elwell: I remember that Professor Whitehead mentioned the result that by using Roentgen rays on the wire it made no difference to the critical voltages.

Professor Ryan: The agencies, and the factors that interfere with critical voltages, and what they are, will depend entirely, to begin with, on our definition of critical voltage.

Mershon at Niagara Falls took as his definition of critical voltage that voltage wherein the convection current loss becomes augmented by corona. Referring to Fig. A: Here is the convection current loss curve OaA that would be if corona did not come in. This curve is the inevitable loss under given conditions. If the conductors have a certain size, and are spaced a certain amount, and the altitude is at a certain value, and the temperature at a certain value, then we will get this loss OabB and not OaA. Now Mershon in his work defined E^I as the critical voltage. I had defined E^{II} in my 1904 paper as this voltage, and I understand that Dr. Steinmetz in his corona work concludes that it should be taken at this same point E^{II}. Through my recent work and that of my colleagues, I have concluded that in the corona problem of the engineer neither of these should be taken as the critical voltage and that the critical voltage should be understood as I have taken it in this paper. One should define some such value like E^{III} as the critical voltage, that is, a voltage value wherein the corona loss has increased to such an extent that it equals the convection current loss. This critical voltage is definite, being only slightly affected by the electrification of the atmosphere.

The value that Dr. Whitehead has in mind is a laboratory value. This value is different from that obtained on the transmission lines, being about one-third greater. He uses the concentric cylinder apparatus. He exposes the atmosphere therein to X-rays (or ultra violet light—any powerful ionization agent) and the atmosphere enclosed in the outer cylinder is strongly ionized; but those ions travel through a balanced radial field, and they don't disturb appreciably the amount of the field.

About the high-tension line however, we have a field that is made up with a figure that you know quite well, its tubes

of force are drawn in Fig. 26 of the paper. The field right around the conductor is balanced through the depth of the corona, i. e. with distances apart of the conductors as they are used by the engineers, the field within the corona zone is just as uniform as it is about the central conductor in the laboratory apparatus. But it is totally different outside of such zone. Between the concentric cylinders, the ions travel back and forth, in a balanced way, and they arrive at the surface of the conductor in a balanced fashion and produce a balanced result. To start that takes about 33 1/3 per cent more pressure because the electric field is not subject to distortion by an unbalanced movement of the ions. In the practical case the electrified particles collect from totally different volumes about the conductor. Out here is a big tube of force of enormous volume (Fig. 26) and within that volume occurs a far greater amount of electrified gas than in this tube; and you have arriving a much greater degree of electrification at some of these circumferential conductor elements than at others. Now traveling particles that are electrified constitute in effect a conductor, and they concentrate the field; the result is, we have in spots an increased stress in the air next to this conductor due to the concentration of the field upon the streams of electrified particles that are formed so easily in unbalanced fields and which act as conductors. The corona starts under those circumstances at precisely the same localized stress as in the laboratory case although the voltage is seventy-five per cent simply because of a 25 per cent concentration of the balanced field.

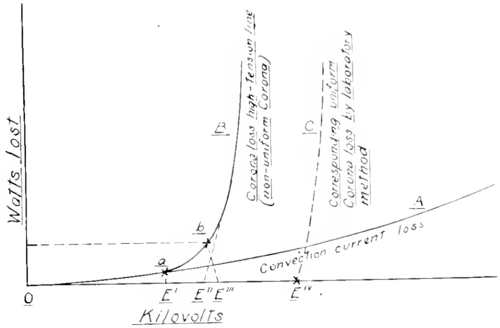


Fig. A

In the practical case the voltage E', i. e. the Mershon critical voltage *a* varies considerably as the shock of ions varies, the voltage E'' locating the critical voltage *b* as used in this paper, varies but little as the shock of ions varies. The chief factor in causing the voltage values of the full corona part of curve *B* to be one-third less than those of *C* is the difference in the form of the electric fields, (see Fig. A.) This difference caused the formation of non uniform full corona in practical case and uniform full corona in the laboratory case. Each is nearly independent of the amount of ionization present. The critical voltage point *a* is varied by changes in the shock of ions present and in the form of the electric field remote from the conductor, while *b*, *B*, *E* and *C* are changed materially only by changes in the form of the field.

A. J. Bowie: I understand from Professor Ryan the subcorona loss is proportional to the altitude above sea level?

Professor Ryan: Yes.

A. J. Bowie. And at sea level it disappears entirely?

Professor Ryan: No, it is very small, however, for engineering sizes of high tension conductors at the usual spacings.

Question: It might be quite a factor in the choice of the transmission line, either in valleys or over mountains?

Professor Ryan: Yes. There is much evidence that subcorona or convection current loss is a factor in the choice of routes at the higher altitudes.

S. J. Lisberger. Does there seem to be any tendency on the part of Mr. West and the others, or have you yourself considered the question of what might be the limit voltage of transmission lines, that is, taking only corona into consideration, and not considering switches, or leakage over insulators and so forth?

Professor Ryan: Yes, some engineers are making studies of this kind, and feel that there is a pretty early limit in the voltage on account of corona. By corona now we mean this general class of phenomena. You can see that if we have to use a No. 0000 conductor in order to operate at 155,000 to 160,000 volts to avoid corona at low altitudes (greater diameters at higher altitudes) that is a limiting proposition if we want to bring into a net-work the power of a small station, say 10,000 kw capacity. That is manifestly above the limit of best economy. It would have to be larger, because it is near sea-level that a size like 4 0 must be had to avoid corona at 160,000 volts. This conductor must correspondingly be larger in diameter in the intermountain region, which is anywhere from 4000 to 10,000 feet in elevation; and the limit has of course naturally been attained in the Central Colorado transmission line. Frequency of course is a factor. If these net-works are going to grow (as they will of course) then it means that before long there will be a demand to put in trunking lines. You call the net-works buses often, and think of them as such, and you put your stations onto them to reach an effective market. By and by there will be a need of making trunking connections between these neighboring large net-works in order to interchange surplus power, i. e. to take in all power wherever it is to be had through the meter, and put it out wherever the market is found over always larger territories. And the question is, what voltage will be available for these trunking connections. Those will be the real long transmissions, and will carry pretty large amounts of power, but after all it will be only the surplus power that one net-work can spare another. An engineer, in connection with an extra long distance transmission line proposed the use of 300,000 volts. At the higher altitudes the convection current loss at such voltage at certain seasons of the year is likely to be altogether prohibitive; that is, the evidence points that way. And I believe undertakings of that character, or undertakings that are leading into practice of that character, will be enormously benefited by every engineer who make measurements of these losses and reports them.

Professor Ryan. Such a transmission will require a very careful preliminary survey, to determine how best to bring it

S. J. Lisberger: In other words, when you get to 300,000 volts you have got to have a subway.

about.

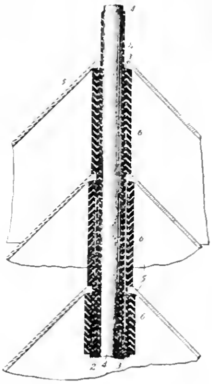
COMMERCIAL SECTION, N. E. L. A.

The Commercial Section of the National Electric Light Association has started an active campaign to extend the uses of electricity in all branches of industrial work and is also actively soliciting membership among central station employees. In accordance with its purpose of improving commercial practice and gathering data on allied subjects committees have been formed with members all over the country. These committees include those on sales, electric vehicles, wiring and equipment standards, residence business, advertising, sign lighting, electricity in rural districts, industrial light, membership, power, street lighting and competitive illumination.

Data and any one or all of these subjects is available to members, who are free to ask for any information they desire. This membership is open to employees of central stations, manufacturing companies, jobbers, dealers, contractors and engineers and costs $2.50 per year in addition to association membership. Application blanks may be obtained from any member or at the office of this journal.

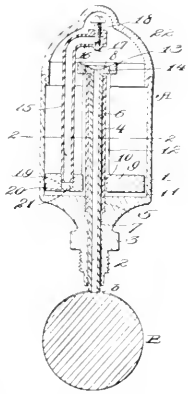
PATENTS

984,156. **Insulating Structure.** Arthur B. Reynders and Jesse E. Mateer, Wilkinsburg, Pa., assignors to Westinghouse Electric & Manufacturing Company. An insulating bushing, comprising a plurality of concentric cylinders of conducting material, separating cylinders of insulating material



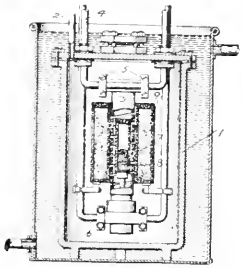
and overhanging bells or skirts of conducting material mounted upon the exposed ends of the cylinders in electrical contact with the conducting cylinders, said cylinders being graded in length between the inner and the outer surfaces of the bushing.

984,373. **Lubricator.** John Edward Hughes, San Francisco, Cal. In lubricators of the type set forth, the combination with a movable part having a cam surface of an oil cup, and pumping mechanism therein including a reciprocatory lubricant supply plunger having a portion projecting beyond



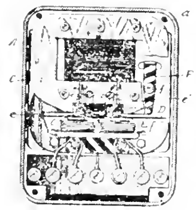
said oil cup and engaging said cam surface, said plunger supplying lubricant to said movable part, a pumping piston in said oil cup, means for connecting said piston to said plunger for movement therewith and means operable during the action of the piston to conduct lubricant to said plunger.

984,119. **Electric Furnace.** Howard I. Wood, Schenectady, N. Y., assignor to General Electric Company. In a furnace the combination of an evacuated chamber, a graphite resistance heater within said envelop subject to disintegration when in normal operation, and a closed envelop inclosing the furnace charge and separated from said heater by an



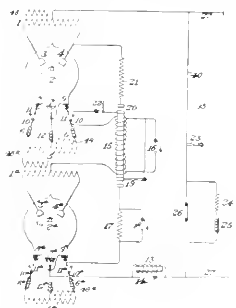
evacuated space, said charge-in-closing envelope consisting of material capable of chemically uniting with such carbon vapor as crosses said space.

984,297. **Electric Meter.** William H. Pratt, Lynn, Mass., assignor, to General Electric Company. In an alternating-current meter, a magnetic core forming a nearly closed magnetic circuit having a central member and two members each



joined at one end to the central member and at the other end separated therefrom by a small air-gap, a potential coil on the central member, a second magnetic core having poles disposed opposite to said air-gaps, and series coils on said poles.

984,248. **Means for Starting Vapor-Converters in Series.** Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York. In a system of electrical distribution, the combination of a plurality of rectifier bulbs operated in series each bulb having two main anodes, two supple-



mental anodes and a cathode, and supply and load circuits and connections therefor, with separate means for each rectifier for passing current continuously between the supplemental anodes and the cathode, together with starting connections external to the bulb between the source which is connected with the main anodes and the supplemental anodes.

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POWER AND GAS

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DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Efficient Technical Expression

The technical man is often bantered because of his clumsiness in expressing thoughts in words, the layman forgetting that there are languages other than words far more efficient for special purposes. Given a draughting board and pen, such a critic would be awkward in expressing his notion of the proper design for a power plant; provided with a list of chemical symbols or a table of integrals, he would find difficulty in interpreting a chemical reaction or calculating transient electric phenomena; furnished with a violin, he might lack the ability to express his emotions in music, or equipped with a brush, he could not paint a picture on canvas. The engineer, the chemist, the mathematician, the musician and the artist are specialists whose thoughts can best be conveyed by these vehicles which excel mere words as the automobile outspeeds the wheelbarrow.

But the technician must sometimes talk, as the automobilist must sometimes walk. Thoughts must often be conveyed by words instead of by more efficient symbols, just as an hydraulic jet may be better adapted to lifting water than is a centrifugal pump. The problem then resolves itself into an attempt to get the best possible result out of a machine inherently inefficient.

We divide output by input to find efficiency. Inefficient writing therefore gives the reader few returns as the result of his reading. An ambiguous sentence does not transmit the full power of the writer's thought; inappropriate words create friction in the reader's mind whose inertia cannot be overcome by a diffuse style. The most efficient composition is one with concise sentences forcefully written to overcome brain inertia and lucidly worded to lubricate mental friction.

The fault lies not entirely with the writer, for there are some readers who get little return from the best literature because their effort is inefficiently applied. Everyone knows the man who continually makes mistakes because he does not follow instructions, no matter how clearly they have been given. So there are readers who are unable to get the full value from an article simply because they have not learned to read properly.

Contracts and specifications are the most common subjects for engineering authorship and often the most glaring examples of careless writing. A well-written letter of application for a position is an excellent introduction; its converse a poor recommendation, as is well indicated in this issue in a case where a man's illiteracy betrayed his false pretensions.

A nobler and more profitable field lies in the opportunity that writing affords in relating valuable experience for the benefit of co-workers, incidentally displaying the author's fitness for similar work and thus gaining him more lucrative employment. Reduplication of effort, trying the same thing that some former worker has proven impossible, constitutes the greatest cause of lost motion in technical progress. This needless waste can be eliminated by voluntary contribution from all workers to the common fund of knowledge which is ours by inheritance and which we should enrich for posterity.

PERSONALS.

R. D. Holabird of the Holabird-Reynolds Company is in New York City.

R. S. Chapman, an electrical engineer of Portland, left last Monday for St. Paul.

Sidney Sprout spent the past week at Merced on electrical engineering business.

C. Walter Jones, sales manager for the Holophane Company, is at San Francisco.

L. E. Sperry, manager for the Western Electric Company in Japan, is visiting San Francisco.

Leon Bly, secretary of the Tehama Light & Power Company, of Red Bluff, was a recent San Francisco visitor.

George B. Burbank, consulting engineer for the Comstock Pumping Association, arrived at San Francisco from Virginia City, Nev., last Monday.

Elam Miller, commercial engineer for the Pacific Telephone and Telegraph Company, has returned to his San Francisco office from the Northwest.

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, has returned to his San Francisco office from a trip throughout the Pacific Northwest.

A. W. Vinson, at one time engineer for the Cutler-Hammer Mfg. Company, at their San Francisco office, has been transferred to the New York office.

I. C. Ashcroft, an electrical engineer of New York, has arrived at San Francisco on his way to Tokio where he will take charge of a large electric enterprise.

D. W. Shanks, general manager of the Trinity Gold Mining & Reduction Company of California and the Rio Plata Mining Company of Mexico, is at Los Angeles.

R. W. Van Valkenburgh, formerly treasurer for the Western Electric Company at San Francisco, has been appointed manager of the company's house at Dallas, Texas.

M. C. McKay, superintendent of the Stanislaus division of the Sierra & San Francisco Power Company and L. C. Hilfrick of Vallecito, Cal., were at San Francisco this week.

A. J. Myers, Pacific Coast district manager for the Wagner Electric Manufacturing Company, returned to San Francisco from a trip to the factory at St. Louis during the past week.

John Coffee Hays of Visalia, manager of the Mt. Whitney Power Company, and also taking an active interest in the carrying out of the La Grange development, was a San Francisco visitor during the past week.

C. E. Grunsky has been unanimously awarded the Norman Medal for 1910 by the board of directors of the American Society of Civil Engineers in recognition of his paper on "The Sewer System of San Francisco and a Solution of the Storm Water Flow Problem."

O. G. Steele, superintendent of the Siskiyou Electric Power & Light Company, arrived at San Francisco from Yreka during the past week. Extension of the hydroelectric system which transmits power from a plant on Fall Creek to Yreka and to Dunsmuir are contemplated. An appropriation of 150,000 miners' inches of the waters of the Klamath River was recently filed for record.

E. V. D. Johnson, manager of the Northern California Power Company, returned to his headquarters at Redding during the past week after visiting the San Francisco office. He said that he was expecting an ample supply of water for power purposes this year owing to the fact that the snow is lying on the mountains instead of being melted off early by warm rains, as was the case last season.

PACIFIC COAST JOBBERS' CONVENTION.

That success has attended the strenuous efforts of the local jobbers that the annual meeting of the national body be held in San Francisco is shown by the following letter:
Electrical Supply Jobbers' Association,

Gentlemen:—The following telegram was received by me today from the French Lick Springs Meeting, Indiana:

"Without opposition Chairman announced April twenty fifth, sixth and seventh, Del Monte. Congratulations.

"CARRIGAN, HOLABIRD."

Very truly yours,

ALBERT H. ELLOTT, Secretary.

An active letter campaign paved the way for this favorable result, two samples indicating the committee's good work:

Go into the Hot Springs Meeting with California on your tongue and California in your smile. Place a gold line under the months of April or June in your calendar. Take your vacation next year in the Promised Land.

Listen to our Committee and they will lead you out of Egypt, across the mountains and the prairies to the land flowing with milk, honey, golf, motoring, etc.

The Grand Canyon of the Colorado will take you back through geological time.

The sequoias of our forests will sing for you as they sang before the Wise Men who followed the Star from the East.

The Hotel Del Monte will be your private residence for the season. Bring your wife, bring your family. Let your watchword be "ON TO CALIFORNIA IN 1911."

If you have cold feet bring them out here and we will warm them.

REMEMBER the date, REMEMBER the place, and REMEMBER that there is a good time COMING when the Electrical Men shall get together at DEL MONTE

We are sending you some literature enclosed.

Very truly yours,

WILLIAM L. GOODWIN,
C. C. HILLIS,
R. D. HOLABIRD,
Committee Pacific Coast Jobbers.

Final Appeal to Reason.

Our pioneer ancestors drove ox teams across the plains in 1849. You are coming over the trail to Del Monte in a special train in April, 1911. You will have scenery by day poker by night. Many are the little Overbagh brooks which are now yearning to trickle from the snow capped domes of the sky piercing Sierras, down your thirsty throats. Flowers yet in the bud will be stirred to bloom at the electric touch of your women folks.

As you sit in the French Lick Springs Meeting try to hear the roar of the Pacific, or the chant of the priest in the Spanish Mission of Carmel. If your spirit so moves you tap lightly on the point of the nose of him who says: "It is such a long distance I am afraid I cannot go." Remember we have here the orange tree that sucks its gold from the depths of the soil, but the tree that bears the crop of little hammers finds in California no congenial soil.

Come with wives, sweethearts, daughters. We will send you back safe, healthy and happy. Everything we do will be electrical all the time.

Very truly yours,

WILLIAM L. GOODWIN,
R. D. HOLABIRD,
C. C. HILLIS,
Committee of the Electrical Supply Jobbers of the Pacific Coast.

P. S.—Read the book we send by this mail.

"The book sent by this mail" was a sixteen page pamphlet giving all the reasons why the meeting should not be held at Del Monte—the entire 16 pages were blank. All delegates at the French Lick Springs were decorated with a handsome badge giving a beautiful representation of the golden poppy, California's state flower A large attendance is anticipated and a valuable session assured.

INDUSTRIAL

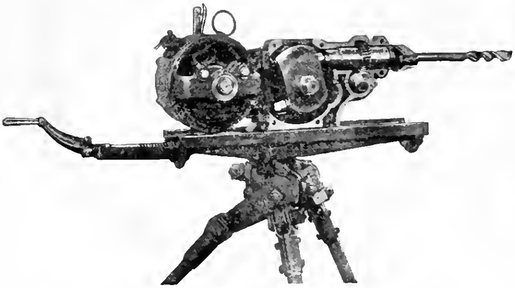
THE FORT WAYNE ROCK DRILL.

The Fort Wayne Type "A" Electric Rock Drill is the result of several years' development and testing under the most severe and unfavorable conditions of actual working operations.

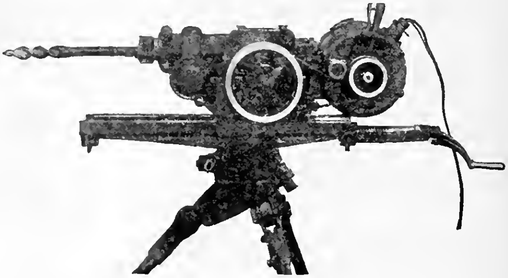
It is a well-known fact that successful appliances can only be developed upon sound, well-founded principles, and experience has proven that the more simple the fundamental principle, the more successful the developed product—this is the keynote in the success of the Type "A" Drill.

Contrasted with other designs making use of flexible shafts, solenoids, springs and other complicated devices, the Fort Wayne drill is unusually simple; consequently it is made exceedingly rugged and effective.

The drill is of the rotary hammer type, operated by an electric motor which is mounted on the frame of the drill proper. The mechanism of the drill consists of two parts, a revolving helve containing the hammers, and the chuck mechanism for holding and rotating the drill steel. An idler is conveniently arranged in connection with the flexible belt between motor and dril, which provides a means of regulating the speed of the drill. Thus all the advantages of hand drilling are obtained without the disadvantages incident to machine drilling.



Right Side of Drill Showing Oil Reservoir and All Covers in Place.



Left Side of Drill Showing Pulleys, Belt Tightener and Belt.

The drill steel is held in the chuck by means of several spring steel plates. When not striking rock, the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground.

The drill casing, striking mechanism, chuck and buffer plates are all simple and very substantial. The floating hammers in the helve are of special steel and are completely cushioned by air chambers so that the jar of the impacts is reduced to a minimum.

The drill steel cannot be jammed into a fissure or a cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge, it has hammered for itself a square shoulder or face, due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring.

Another point of excellence in the Fort Wayne drill is the simple method employed for the removal of cuttings from the hole being drilled. A special designed steel, developed by our engineers, removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the big item of pressure systems, including tanks, hose, water lines, etc., is eliminated, to say nothing of the cost of maintenance and inconvenience incident to such systems.

While these drills are ordinarily used in a horizontal position, they can be used in any position and will drill holes at any angle.

The ease with which power can be transmitted throughout the workings by wire and the rapidity with which the lines can be changed enables the operator to advance his work more rapidly than could be done when using other types of drills.

A comparison of tests of the Type "A" drill and air drills shows that the former requires about 1½ to 2 h.p., including transmission loss, while an average air drill requires from 12 to 18 h.p. for the same work. This is due to the design of the drill, the much greater efficiency of the electric motor and the small loss in transmitting power to the drill.

The simplicity and ruggedness of design of the Type "A" drill is a guarantee that the cost of maintenance will be exceedingly low.

Owing to the saving in power, the low cost of maintenance and the high efficiency of the Fort Wayne drill, from 50 to 70 per cent can readily be made, under ordinary conditions, upon the investment.

The drill can be operated with either an a. c. or d. c. motor and since the motor is entirely independent of the drill the change from one to the other is easily made. Bulletin No 1120 from the Fort Wayne Electric Works gives further details about this drill.

AUTOMATIC FUEL OIL REGULATION EFFECTING STEAM POWER PLANT ECONOMY.

Practically all oil fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner, the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant.

The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Co., Los Angeles, Cal., where under the directions of the Chief Engineer, one man stationed near the oil pumps, running at practically constant speed, controlled 18 boilers or 54 burners by opening or closing a bleeder valve on the oil pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore patent automatic fuel oil regulating system.

This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners, and the supply

of air for combustion, for any number of boilers, all from a central point. The results are: increased boiler plant efficiency, the practical prevention of smoke, and the decrease in the maintenance cost of boiler equipment, due to a more uniform manner of firing. This was first installed at the Redondo plant of the Pacific Light & Power Company in 1907. Here the regulating system is used to control the entire plant of 18 boilers of 600 h.p. capacity each, and the increased economy, due to uniform rate of firing is evident.

Under actual operating conditions this system of regulation has been found absolutely reliable. In 1909 or about two years after this apparatus was installed, Mr. A. C. Balch, general manager of the Pacific Light & Power Company, expressed his opinion in the following letters to the designers:

"Referring to your inquiry, we are pleased to advise you regarding results with your automatic regulating system.

"As you know, we have in our plant at Redondo, 18 Babcock & Wilcox boilers, each rated at 604 h.p., with three burners per boiler, or 54 burners in all. The entire boiler plant has now been equipped with the Moore automatic fuel oil regulators for the past year, which control the steam pressure, the fuel oil pressure, the supply of steam to burners for atomizing the oil, and the operation of boiler dampers for the purpose of regulating the supply of air for combustion.

"With this system we maintain practically a uniform steam pressure while in operation. One-third of the plant has been under automatic control for a period of over 18 months. The remainder as stated above, was equipped with your regulators one year ago and the entire plant is now operating under this condition. During this time we have never suffered an interruption of service, or loss of steam pressure, due to failure of regulators to operate; they are simple in design and positive in action and we find them capable of ready adjustment by the operative firemen.

"Our plant is subject to a widely swinging railway load and we find under all conditions the boilers respond to these fluctuations of load almost instantly. As the result of installing this equipment we find the load is more equally divided among all of the boilers in service than under hand firing, and the boilers are free from abuses due to excessive rate of firing periodically experienced with hand regulation on variable load. It is usually the case, in attempting to hand regulate fires on reduced air supply, that the chimneys will smoke frequently on variation in loads; as a result of the automatic system of regulation, the smoke nuisance has been reduced to a minimum.

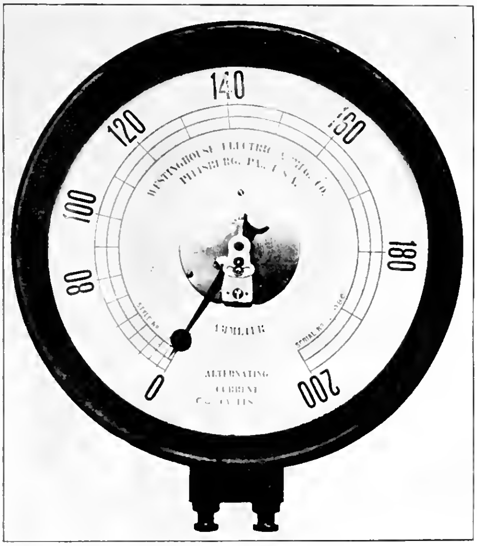
"We consider the regulating system thoroughly practical, reliable, economical in operation and a demonstrated success."

At this time, 1911, after this system has been in operation a number of years, the Southern California Edison Company is installing a similar outfit. This in itself is conclusive proof that this system tends to make the operating conditions ideal, particularly in the plants where the load is variable and difficult to handle by hand regulating on account of frequent adjustments. A bulletin "Unnecessary Losses in Firing Fuel Oil and an Automatic System for Eliminating Them" can be obtained at any of the offices of Chas. C. Moore & Co., Engineers.

LONG SCALE SWITCHBOARD METERS.

A meter with readings easily legible, for use in large installations where this characteristic is essential, requires a long and well illuminated scale. The long scale has been obtained by meter manufacturers in two ways. The simplest and most obvious way is to extend the pointer and the radius of the scale of a short scale meter until the desired length of scale is obtained. The other method of obtaining a long scale is to increase the arc subtended by the scale, a method involving a completely new design of meter.

It was this second method which was adopted by the Westinghouse Electric & Manufacturing Company in placing on the market their complete line of type F alternating current switchboard meters. These are round pattern meters of the usual size, about 9½ inches in diameter, with scales subtending an arc of 300 degrees and about 14½ inches long. The length of scale usually found only in the large illuminated dial meters is thus obtained in a meter of normal size. There is no metal front on the meter but instead a round glass cover is used. This makes it possible to thoroughly illuminate the dial from the front and thus avoid the use of special lamps.



Long Scale Switchboard Meter.

The meters operate on the induction principle. The torque depends on the action of a rotating magnetic field on a light, pivoted drum. This principle makes connections to the moving element unnecessary, and, by avoiding the use of a copper coil or iron core for the moving part, reduces the weight on the pivot bearings and consequently the friction. This leads to accuracy and long life. The moving element also has inherent damping qualities, and the torque developed is very high. The controlling springs, which balance the torque, are made of a special alloy, tempered and aged to insure permanence under all conditions.

The type F meters are furnished as ammeters, voltmeters, single-phase and poly-phase wattmeters, power factor meters, and direct-reading frequency meters. All of these meters utilize different forms of the induction principle. Type F single-phase and poly-phase static ground detectors are also furnished, harmonizing in size and general appearance with the rest of the line. The type B synchroscopes and the type FL direct current meters made by the Westinghouse Company are also of the same size and appearance, so that a complete harmonious switchboard can be arranged.

TRADE NOTES.

The General Electric Company has sold a Curtis Turbine to Sanderson & Porter for the use of the Grays Harbor Railway & Light Company at Aberdeen, Wash. The rating is as follows: One A. T. B. 4, 1250 k.v.a. (1000 kw. at 8-10ths p. f.) 1800 r.p.m., 2200 v., horizontal, condensing turbine generating set, together with one 25 kw. motor generator exciter set.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Sierra Nevada Water & Power Company has been incorporated by C. A. Wright, Frank Smith, and E. McGettigan with a capital stock of $25,000.

GERBER, CAL.—The Gerber Water & Light Company has been incorporated by Edward H. Gerber, Geo. W. Peltier, F. W. Peltier and F. W. Kiesel, all of Sacramento, Cal., with a capital stock of $50,000.

VALDEZ, ALASKA.—The Mineral Creek Power Company, capital $500,000, has been incorporated by Joseph Bourke, F. M. Boyle, C. D. Shaw. The new company will soon begin construction work on a dam and power house. The dam will be 50 feet in height and will later be raised to 150 feet, giving 2000 horsepower. The company will also construct a customs mill to handle ore. The erection of an aerial tramway extending the length of Mineral creek is contemplated.

FINANCIAL.

SILVERTON, ORE.—The Silverton water bond issue to the amount of $75,000 has been carried, and C. H. Green, a consulting engineer of Spokane, Wash., has drawn the plans and will supervise the construetion work.

ORLAND, CAL.—The Trustees has passed a resolution declaring their intention of calling a special election for voting bonds for municipal improvements. The date for the election will be fixed in the necessary ordinance, which will be introduced at the next meeting. The resolution segregates the bond issue proposed into $23,000 for waterworks and $27,000 for sewer system.

TRANSMISSION

EUGENE, ORE.—The Oregon Power Company is installing three new transformers in the new substation recently added to the present plant.

MEDFORD, ORE.—A plant at Prospect to generate 10,000 horsepower of electricity has practically been decided upon by Colonel Ray of the Rogue River Electric Company.

CHICO, CAL.—A power line has been construeted by the Saeramento Valley Power Company from this place to Butte Creek, several miles southeast of town, to furnish power for new dredges under construction.

EL PASO, TEX.—A permit for the construetion of a $10,000 addition to the steel power plant building of the El Paso Electric Railway Company on South Santa Fe street has been granted to the Stone, Webster Co.

TURNER, ORE.—C. H. Cannon, local manager of Balfour-Guthrie Company, of Portland, Ore., has filed on the water rights of Mill Creek. He expects to develop from 1800 to 2000 horsepower for power purposes.

PORTLAND, ORE.—The Washington-Oregon Corporation has completed negotiations for taking over the plants of the Kalama Light & Power Company, the Rainier Light & Power Company, and the Kelso Light & Power Company.

KELSO, WASH.—The development of over 8000 horsepower at the falls of the Kalama river, where now there is only 600, the rebuilding of the 12 miles of power line from the power house down the Kalama river, and the construction of a power line from Kalama river through Kelso to Chehalis and Centralia, Ore., are some of the plans of the Washington-Oregon Corporation, states E. W. Hall.

MERCED, CAL.—The directors of the Exchequer Mining & Power Company held a meeting last week in the office of Dr. F. S. O'Brien the secretary and manager. The situation as a result of the recent floods in the Mereed River Canyon was gone into and it was decided that the new powerhouse to be erected should occupy a different site than was occupied by the building destroyed by the floods.

ILLUMINATION.

BOISE, IDAHO.—Cluster lights for the business section of the city will probably be installed.

WHITE BLUFFS, WASH.—This place will soon install a system of lights and electric system. Several dynamos will be installed.

ELLENSBURG, WASH.—An expenditure of $3000 will be made for improvements to the local municipal light plant this year. Engineer Miller states that 2000 horsepower will be generated instead of 600.

KLAMATH FALLS, ORE.—A proposition has been presented by the Siskiyou Electric Power Company for a franchise to build a power line into Klamath Falls for lights and power purposes during the coming year.

EUGENE, ORE.—The Oregon Power Company, H. M. Byllesby Company operators, has purchased the electric light plant at the town of Coburg, in northern Lane county, and will supply that place with lights and electricity.

SALEM, ORE.—The Salem Board of Public Works has planned to have cluster lights along the principal streets of the city. The executive committee has been authorized to go ahead and have plans prepared for their installation.

EAGLE POINT, ORE.—Surveys have been completed for the establishment of an electric light plant here. A power station will be located on the falls of the Little Butte Creek. The present plans call for the completion of the project by fall.

FORT MASON, CAL.—Bids will be received at the office of the Quartermaster, San Francisco, until March 1 for constructing an addition to the power house and installing pumping machinery at the U. S. Army General Hospital, Presidio of San Franeisco.

SAN LUIS OBISPO, CAL.—Manager G. L. Howard, representing the Gas & Electric Company, says that when the company derives its power from the Santa Cruz Mountains for electricity it will arrange to pipe natural gas from the Santa Maria field to this city.

GRANTS PASS, ORE.—The City Council has granted to A. W Butler of Minneapolis, P. B. Herman and E. L. Churchill of this city a 50-year franchise for a modern and up-to-date gas plant, the plant to be completed within 8 months. Plans are now being worked on and it is probable that actual construction will commence within 30 days.

NEEDLES, CAL.—E. H. Rose of Los Angeles has purchased the property of the Needles Light & Power Co., at this place. The plant is to be improved at once, the present plant being duplicated and a gas plant will be ereeted to be opated in connection with the plant.

SAN FRANCISCO, CAL.—At the annual meeting of the stockholders of the Pacific Lighting Corporation directors were elected as follows: George H. Collins, Charles Holbrook, C. O. G. Miller, A. Schilling and F. W. Sicklen. The directors organized by re-electing officers, namely: C. O. G. Miller, president; George H. Collins, vice-president, and Horace H. Miller, secretary. The Pacific Lighting Corporation succeeded the Pacific Lighting Company which was organized May 20, 1907, and is a holding company. It owns the entire outstanding stock of the Los Angeles Gas & Electric Corporation and practically the entire stock of the Pasadena Consolidated Gas Company, as well as other assets.

LOS ANGELES, CAL.—Following the election of permanent officers this week, the Southern California Gas Company, the $10,000,000 corporation that has taken over the business of the Domestic Gas Company, and which plans to build high pressure gas systems between Los Angeles and the cities of the San Bernardino Valley, will begin immediately work on a number of extensions. These officers will direct the affairs of the company: W. G. Kerckhoff, president; A. C. Balch, first vice-president; A. N. Kemp, second vice-president, and comptroller and I. M. Farman, secretary. The first work of magnitude to be undertaken is the extension of the Glendale distributing system. The company already has spent $100,000 in this work and the extension will cost about $50,000. Fully ten miles of pipe will be laid.

TRANSPORTATION.

SAN DIEGO, CAL.—The San Diego Electric Railway Company will soon extend its line to Escanto Heights. The M street car line also will be extended.

VALLEJO, CAL. President T. Gregory of the Vallejo & Northern Electric Railway Company, has applied for a 50-year franchise for an electric line over the tide lands leading to the wharf of the Monticello Steamship Company.

HAYWARD, CAL.—I. B. Parsons, president of the Bank of Hayward, has purchased a franchise for a street railway to run from the Southern Pacific station via Front, C, Commercial and B streets ao the eastern city limits.

SACRAMENTO, CAL.—After the bill giving the right for the city of San Francisco to use any of the tracks of the United Railroads had been signed by the Governor it was found that the omission of two words, "an act," nullified its legality.

SAN FRANCISCO, CAL.—The Southern Pacific Railroad Company is receiving bids for the construction of a substation which is to be erected in Berkeley in connection with the electrifying of its ferry lines on that side of the bay. The work will be executed in reinforced concrete.

MARTINEZ, CAL.—Stating that the Oakland and Antioch Electric Railway Company intended to construct a scenic railroad to the summit of Mount Diablo, A. W. Maltby, one of the directors of the road, has asked the Board of Supervisors to grant his corporation a franchise for a line from Concord to a point known as Castle Rock, situated at the base of the famous mountain.

SEATTLE, WASH.—Plans of the Seattle Electric Company for the electrification of the Madison street cable line were made public when the Board of Public Works granted a permit for the reconstruction of the cable line between 21st avenue and Broadway last week. The plan, as explained by Chief Engineer Geo. J. James, means the running of cable cars between the water-front and Broadway.

ALAMEDA, CAL.—The installation of overhead wire from the Southern Pacific power house on the tidal canal to the poles throughout Alameda was commenced by a force of workmen this week, and railroad officials announce that the first electric trains would probably be in operation by June 1, by which time they expect the entire power system will be ready for work. The new steel passenger coaches are expected to arrive by the end of this month. The coaches will be practically wreck proof. They will be the same style as used on the subway in New York City.

STOCKTON, CAL.—The San Joaquin Valley Electric Railway Company, now that its franchise to French Camp via McKinley avenue is practically assured, announces that it will be carrying passengers and freight between Stockton and Modesto, via French Camp, Manteca, Ripon and Salida, by early summer. The company's newly graded roadbed between French Camp and Modesto was but little damaged by the high water. The new reinforced concrete bridge over the Stanislaus River at Ripon is well under course of construction and was only temporarily delayed by the high water of last week. The rails for the line have been secured and when the McKinley avenue franchise is formally awarded the work of grading between French Camp and Stockton will be taken up and the laying of rails will soon begin.

TELEPHONE AND TELEGRAPH.

DAYTON, WASH.—The board of directors of the Mt Vernon Telephone Company will receive bids up to March 1 for the furnishing of about 460 tamarack telephone poles along the line of the Mt. Vernon Telephone line from Granger mountain to this city, a distance of 12 miles. Further information on application to J. W. Stevens at Dayton, Wash.

SAN FRANCISCO, CAL.—The Pacific and Home telephone companies have presented their financial statements for the last six months to the Board of Supervisors and members of the Board questioned the representatives of the opposing companies on their services to the public. Accompanying the statement the Pacific Telephone & Telegraph Company requested the privilege of discontinuing the four-party lines. It was stated that the four-party lines interfered with other service, that it was being furnished at a direct loss to the company and that if it were discontinued the company could increase its service on other lines. Vice-President S. G. McMeen represented the Home Telephone Company. He said that his company was just making expenses and quoted figures from his statement as proof. He said the total earnings of the Home company for the six months ending December 31, 1910, was $174,945.47, their total expenses $149,866.19, leaving a net earning of $25,129.28.

WATERWORKS.

BAKERSFIELD, CAL.—A franchise has been granted by the Supervisors to Richard Hastings for a pipe line for water for the Lost Hills oil district and the new town of Lost Hills.

PLACERVILLE, CAL.—C. F. Peters has filed notice of the location of 100,000 inches of the water flowing in the middle fork of the Cosumnes river at a point to the west of the mouth of Perry Creek for power, irrigation, municipal and domestic purposes.

SAN DIEGO, CAL.—The Board of Supervisors has granted the petition of the property owners of San Ysidro colony for the organization of the San Ysidro irrigation district. Districts will be organized for the purpose of developing water to supply San Ysidro.

OAKLAND, CAL. Persistent rumors to the effect that negotiations are in progress between the People's Water Company and the heads of the Bay Cities Water Company for the purchase and absorption of the former's plant by the latter concern are emphatically denied by officials of both corporations.

INDEX TO ADVERTISEMENTS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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INDUSTRIAL APPLICATION OF THE ELECTRIC MOTOR

The February discussion of the San Francisco Section of the American Institute of Electrical Engineers was devoted to the adoption of electric drive in a number of industries hitherto employing some other forms of power. All these industries were well established before the recent developments in electric motors, and their requirements were being well met by the agents already in use. Particularly was this the case in pumping oil, in drilling rock and in city hauling. All these things can now be done better with electricity.

Recent extensions of transmission lines have placed electric power within reach of many oil fields, mines and towns formerly isolated from this advantage. Electrical manufacturers have made a close study of the problems to be put and have developed special types of apparatus to successfully perform the required duties. Electric power is shown to be more economical and more convenient and is consequently gradually displacing its competitors.

The various papers presented at this meeting are printed in the pages following. In each case the author states the difficulties to be overcome and shows how the electric motor has been adapted to each kind of work. Electricity is not claimed to be a panacea for industrial troubles but may be profitably applied in many instances where it is found advisable to discard other apparatus in order to install electric drive.

Typical Steam Pumping Rig in California Oil Fields

The industries treated are of especial interest to the Pacific Coast, similar papers in Eastern sections being more concerned with electric power in the factory. One industry, that of irrigation, was unavoidably omitted, it being among the most important new users of electric power. On the whole this symposium is an admirable presentation of the manner in which local conditions have been improved by electric power. The papers are printed in the order in which they were presented at the meeting. In several cases considerable data was preliminarily published in this journal of Feb. 18, 1911.

THE ELECTRIC MOTOR IN OIL WELL SERVICE.

BY W. F. LAMME.

In certain Eastern oil fields the electric motor has been in use for several years, but in California only recently have serious efforts been made to electrically operate oil wells. Since the problem involves a wide distribution over much territory the distributing system must be alternating current, and the induction motor is the only available type fitting the case.

By the use of alternating current, at say, 11,000 volts, three-phase, the distribution losses are reduced to a minimum, whereas the old method of steam distribution is very wasteful, even with the care taken to cover the steam pipes with heat confining covers and to bury the pipes in the ground.

But before electric drive can be adopted in the oil fields an ample supply of electricity must be available to the user and it must be offered at a reasonable rate. During the past year the San Joaquin Light & Power Company have constructed distributing lines through the oil fields at Coalinga, distributing at 11,000 volts four wire star, using 6600 volt distributing transformers, and have placed electric power at the door of the operator, offering it at a reasonable rate.

This makes a condition where the operator has now only to convince himself that the work can be done with the electric motor at a cost that will pay him to make the change from steam to electricity.

In passing, let me say that some oil properties furnish enough gas to run gas engines to do all their pumping. While a gas engine requires considerable attention, and some repairs, and while the first cost is large, yet this form of power in the oil fields, where available, is cheap. We have not yet secured enough data to warrant a statement that the electric power is cheaper on the average than gas power, but comparing with steam power, the data is certainly against the steam.

In order that we all may understand the kind of work required of the electric motor, let us divide it into the four classes of pumping, cleaning and drilling the well, and moving the oil.

Pumping.

An oil well consists first of an outer pipe ranging in size from 16 to 6 in. called the casing, which is put in while the well is being drilled. Inside this casing is placed a second string of pipe ranging in diameter from 2 to 3 in., called the tubing, which forms the walls or stock of the pump. Inside the tubing is a series of rods screwed together, to the lower end of which is attached a sucker with a ball valve, to catch and raise the oil in the tubing.

As there is only one rod and one lift the load is fluctuating, particularly in the case of a deep well. There is no objection to this fluctuating load except that it increases the copper losses in the motor, thus lessening the possible output. Since copper losses increase in oil well work, a motor with small copper losses is best.

When pumping by steam the engine is run direct upon the throttle without a governor, and so the fluctuation in the stroke is much greater than with the motor (unless the motor is run with much resistance in its secondary circuit). Some oil operators claim this is a good thing, for they say it lessens the strain on the pump rod, and so lessens breaks in this rod. However, this view is not being supported in practice, the motor and gas engine, both of which give a more uniform stroke, do not produce any more broken rods, and to date there have been less breaks. Undoubtedly the more regular movement raises more oil, and this is an argument in favor of a more uniform drive.

The number of strokes per minute in pumping an oil well varies between 16 and 26, depending upon the kind of oil, whether heavy or light, the length of the stroke, the strength of the rods and the tendency to sand.

Cleaning.

The sanding or clogging of a well explains the necessity of cleaning it. Oil is found in loose beds of sand in the earth, and this sand and oil are frequently under considerable pressure, especially when a well is new. The sand is inclined to clog the lower end of the pump stock, and frequently it so stops the flow of the oil into the pump, as to necessitate cleaning away the sand. This is done by raising all the pump rods and tubes (in sections of about 60 feet each) and then introducing a bailer to remove the clogging sand. The bailer is a piece of pipe closed at the lower end by a ball valve, having a projection to open the valve when bailer strikes the bottom. Sometimes this sand gets so tight that a drilling tool must be lowered to cut through the sand to the oil producing strata.

After the objectionable sand is removed, the tubes and rods are replaced, and the well is again ready to be pumped. A motor for well pumping should have good performance for continuous service and as little loss as is consistent with good design and low maintenance. For cleaning it is important to have a heavy pulling motor, and efficiency is of little moment, for the process of cleaning takes only a few hours per well. These two features of good performance and heavy pull, are at present combined in one motor, by the use of a three pole, double throw switch, throwing the stator windings in star for pumping, and in delta for cleaning, the delta connection giving approximately three times the pull that the star connection gives.

In cleaning, higher speeds are required than in pumping, these higher speeds being secured by changing pulleys to give from 1½ to 2½ times pumping speed, depending upon the size of the motor and the nature of the work. The smaller the pulley, the longer the time required to clean a well, and the smaller need be the motor. This question of speed and time for cleaning is still a disputed point, that is, how large should the motor for cleaning be compared to pumping requirements.

This combination of a cleaning and pumping motor in one, has not given the best results for either service, as cleaning requires a rugged motor with resistance and a controller large enough to do the heavy work, which is a handicap in pumping, and makes the equipment expensive, while the motor for cleaning is light for the work. But as it stands, the equipment is well fitted to a condition where cleaning is done infrequently, say once in two weeks or a month.

In oil well work to clean the well is at present found to be necessary. But attempts are being made to

introduce screens into the well, which it is claimed will keep back the sand and so prevent sanding. Should this plan prove a success then the cleaning feature will become a secondary matter, and the pumping equipment can then be greatly cheapened.

Drilling.

In the process of drilling an oil well, a cutting and hammering tool of considerable weight is drawn up and dropped much as in a pile driver, except that with the drilling outfit the tool is at the end of a line which springs, the action being something like that of a weight at the end of a spiral spring. If you take hold of the other end of the spiral with the weight downward, and move it up and down, striking the ground with the weight, the heaviest blow will be made at a certain speed, the downward fall of the weight must not be retarded by the spring, and the spring must catch up the weight as soon as the weight has struck the blow, otherwise an improper reaction takes place and time will be lost.

The condition illustrated by the spring and weight is the one sought in drilling an oil well, and so the motion given by the engine or motor must vary to accomplish this effect. At first thought the condition named may seem easy. But when we consider the weight of a long steel rope, which is the spring, it is noted the condition is continually changing, which together with the different kinds of ground drilled, makes quite a problem, for it is always the aim to maintain a maximum rate of digging.

In the process of drilling, water is introduced into the hole, which aids the cutting and facilitates the removal of the waste. After a certain amount of drilling is done, the drilling tool is drawn up, and the bailer is lowered into the hole, filled, brought to the top, emptied, then lowered several times until the hole is clean and ready for the drilling tool again.

In this process of bailing, high speeds are essential, especially where the well is deep, otherwise much time will be lost. In the case of pumping, time can be given to change pulleys, but in the case of drilling, this is not permitted, so the motor has to furnish the faster speed.

Mr. Clark, engineer for the South Penn oil fields of West Virginia, made a design of motor for that field, as follows: The motor has two stators on a single base, one stator stationary, the other arranged to be moved about the shaft by means of a worm gear.

The rotor is in two parts, solid on one shaft, and with one winding extending through both parts, it is wound squirrel cage with a short-circuiting ring at each outer end. Both parts are arranged to give double speed.

The worm gear adjustment gives nice ranges of speed for drilling, and the double speed feature is used where high speed is needed, as in bailing. This motor has also the star delta arrangement, so enormous pulls may be exerted when necessary, such as when the tool sticks or a string of casing becomes tight in the well. Excellent results are reported in its use.

In oil well drilling experiments are being made with a circulating pump, or circulator, which forces water down the casing, and this water raises the waste on the outside of the casing. This may be so perfected that bailing will no longer be needed, and so the high speed feature on the drilling motor may be eliminated. This will simplify the motor and make it less costly.

The rotary drilling rig is coming into use, and is easy to drive by the use of a motor, for no special speed or different feature from the standard motor will be necessary, and it is possible constant speed will be all that is required. If so, then the drilling problem, so far as the motor is concerned, will be easy. The rotary drill is simply a turning tool which bores itself through the ground.

Moving the Oil.

To complete the circle, and do away with steam drive entirely, there should be some additional means of moving the oil from the sump to the storage or the pipe line. Part of the movement is now done with a tail pump or a plunger pump, on the opposite end of the beam from the oil pump. This does well, except in the case of reservoirs or sumps beyond the reach of the tail pump. At present such wells use a sump pump or separate reciprocating steam pump, but to operate this a steam line has to be run, and there is considerable expense in its installation. Some sort of simple high speed rotary pump devised to pump oil against a head of about 100 lb. per square inch, should prove an acceptable substitute.

This work of moving the oil by electric drive has not yet been taken up, and in doing so, the engineer must not forget that a little rise in temperature, a little heat in the oil, greatly facilitates its movement, hence the apparent necessity of retaining steam drive for sump pumping.

But this small quantity of heat can be supplied by electric coils, or by a small portable boiler set beside the reservoir and using but a few gallons of oil per day.

In summarizing it is seen that considerable progress has already been made in adopting the electric motor to oil well work, though an oil well pump, so far as power is concerned, is an inefficient affair. The electric motor is a high speed machine, the well pump a slow speed machine, and the link between the motor and the pump is not efficient, frequently half the energy applied being wasted before the pump is reached. To date the application of the motor is made in one of two ways:

1st. The belt and counter shaft plan, in which the motor is belted to a counter-shaft and the counter-shaft to the main drive, a large wooden wheel supported on two wooden posts which operates a walking beam, which in turn operates the pump.

2d. The motor itself has a counter-shaft, which counter-shaft is driven by gear and pinion, and in turn is belted to the main drive as in the first instance.

In both instances a counter shaft is necessary, as well as gears in one instance, also the walking beam and main drive are far from an efficient means of reaching the pump. Tests have shown that some pump rigs waste as much as 50 cents of current per day, to make up the loss between motor and pump, that is $15 per month, where it looks as if $5 should cover the loss. There is great need for a more direct means of getting from the motor to the well, and at the same time permit the use of a higher speed, therefore a more efficient motor.

MOTORS FOR DRILLING AND PUMPING IN OIL FIELDS.

BY M. RHINE.

While it is true that motors have been in use for some time for both pumping and drilling in the South Penn oil fields, it has only been within the last few months that it has been actively considered for the California fields. While the electric manufacturing companies have realized that this presented a big field to be developed, they were unable to do anything owing to the fact that there was no electric transmission line into the oil fields that could furnish power at reasonable rates.

Within the last year the Pacific Light & Power Company of Los Angeles has looked into the power conditions of the oil fields and come to the conclusion that if the electrical manufacturing companies could build a satisfactory motor, the oil fields would be a large market for the sale of electric power. With this in mind, the Pacific Light & Power Company carried on a series of tests in the Sherman fields at Los Angeles and it was proven to them conclusively that the electric motors were satisfactory in every respect. At present the transmission lines are in the Coalinga fields and lines are now being extended into Moron, Kern River, Midway and McKittrick fields.

After a well has been drilled and cased, a 3-in. tubing is inserted, which runs to the bottom of the well, and at the bottom of this tubing is placed the pump barrel, or pump proper, and the well is then ready for production. Usually there is installed a battery of boilers at a central point and steam feeds are run to the various steam engines. The steam engine is belted to the large band wheel, the band wheel is then connected to the walking beam through a crank, the walking beam in turn being connected to the pump rods.

The number of strokes per minute is varied from day to day, the minimum being about 16, and the maximum about 30 per minute, depending upon the conditions of the well. As an example—providing they should be pumping at 25 strokes, it perhaps is pumping too much sand, and it is then necessary to reduce the number of strokes to say 23 or 22, whatever the case may be. This, of course, is only true in the new fields. This, therefore necessitates the use of the variable speed induction motor. It is also very essential that the upward stroke of the pump be considerably slower than the downward stroke.

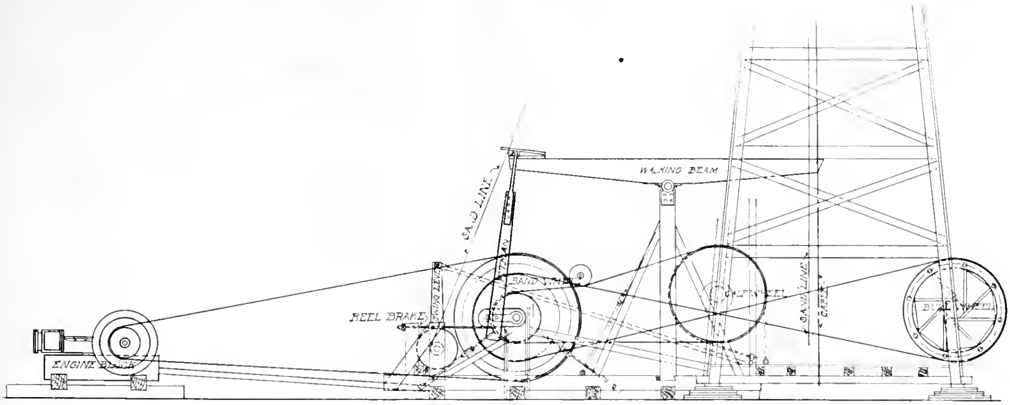
In the new fields, the pump often becomes sanded and it is therefore necessary to clean out the well. The customary method is first to pull out the pump rods and pump, which takes about 20 h.p., and then to pull out the 3 in. tubing, which will take perhaps 25 h.p. There are times, however, when it is impossible to start the pump rods and pump, and it becomes necessary then to pull up the 3 in. tubing, pump, pump rods and tubing full of oil. This requires a considerable amount of power, which will range from 50 to 70 h.p., depending upon the depth of the well. After the tubing has been pulled out of the well, they then run down a bailer which cleans out the sand.

When electrifying any particular lease, there are three problems to be considered: First, a lease with a large number of wells, the wells being such that they require cleaning only at rare intervals. It might be well to install small variable speed motors for pumping and to have several portable motors for cleaning the well, the advantage in this case being the low first cost, while there is the disadvantage of transporting the portable motors and the extra labor involved. The second proposition to be considered is where a large lease is concerned with cleaning the wells quite often. Under these circumstances, the motors installed should be of sufficient size to take care of both pumping and cleaning the wells. The third proposition applies to leases operating a small number of wells, and they should, without any doubt, install motors of sufficient size to take care of both pumping and cleaning. The California fields require cleaning quite often and therefore the large motor only should be considered.

I have forgotten to mention that it is necessary, especially when cleaning a well, to have the motor reverse its direction of rotation. The oil operators have been accustomed to reverse the steam engine from full speed forward to full speed reverse, and it is therefore necessary to have a motor that will stand this hard usage. The electrical manufacturers are therefore confronted with the following problem: to design a variable speed reversible motor with high starting and break down torque and efficient, having good electrical characteristics at the low horsepower required for pumping and at the same time to give a slower speed in the upstroke than for the down stroke. The variable speed and reversing is accomplished by using a form wound rotor of the slip ring type, controller and resistance, the variation of speed being accomplished by varying the amount of resistance in the rotor circuit.

As stated before, the pumping horsepower is considerably less than the horsepower required in cleaning, but inasmuch as the pumping operation is for about 95 per cent of the time, special attention had to be given for both good efficiency and power factor at the pumping load. This is accomplished by using a Y-Δ motor, the Δ connection for cleaning or the high horsepower duty, and the Y connection for the pumping or low horsepower duty. As an example—a motor rated at 20 h.p. for the Δ connection would theoretically have a rating of 6 2/3 h.p. on the Y connection. The Y connection, however, will be slightly higher than this, due to the fact that the excitation of the motor is considerably less than when running on the Y connection. With a motor of this design, the power factor and efficiency is practically the same when running at full load on the Y connection, as when running at full load on the Δ connection, the control apparatus having the same effect in either case. The changing from Y to Δ connection is accomplished by the use of a triple pole, double throw switch mounted in any convenient place, usually however on the motor frame.

There are several ways to connect the motor to the present wells—one method is to belt the engine shaft, using it as a countershaft by merely taking off the large fly wheel and installing a suitable pulley in its place, disconnecting the engine connecting and



Sketch of Oil Pumping Rig.

eccentric rods, or, instead of using the engine shaft a new countershaft could be installed. Another method is to install a back geared motor, the motor to set on the present engine foundation, and belted direct to the large band wheel.

Up to this time there has been quite a number of motors sold for this work, both of the belted and the back geared type. The saving to be effected by the use of electric power is considerable—in one particular case the writer's investigations showed that the cost of power would about equal the cost of boiler up-keep, that is, cleaning tubes, renewal of tubes, etc. With the installation of motors, the cost of boiler men, fuel, etc., is eliminated. In the Midway field there is one particular lease that is operating 14 wells and it is necessary to buy water for boilers from an outside source. The cost of water alone was $1200 per month, while it is safe to say that the cost of electric power for these same wells will amount to not more than $600 per month. The company, at the same time, will be saving fuel, boiler men and up-keep of boilers and steam feed mains. The total cost to electrify these 14 wells will be in the neighborhood of $10,000 to $11,000. This is a very new subject with the oil operators, but, from the favorable way they look upon it, it is safe to say that the electric power is the coming power for the oil fields.

THE VALUE OF ELECTRIC COMMERCIAL VEHICLES AS POWER CONSUMING DEVICES.

BY C. W. HUTTON.

One of the most important features to be considered in connection with procuring profitable industrial power business for the central station is to select that class of power business which will cost the least to handle. It necessarily follows that the class which will improve the load factor most will fulfill this condition. There is no power consuming device that approaches the potential possibilities, as a curative of not only the daily load factor, but the yearly load factor possessed by the electric vehicle, particularly the electric commercial type, which has a duty to perform practically six days a week and every week in the year. It is this type therefore to which my remarks will be confined.

The modern electric commercial vehicle is so designed that its battery may be properly charged after nine or ten o'clock at night and before seven o'clock in the morning. Additional wholesale business with not a cent's increase in station investment. In the commercial vehicle, due to the nature of its service, it is usually impossible that it should be placed on your lines for charging during the day time. With the commercial vehicle it is but seldom that your customer has but one vehicle. It would seem that the tremendous desirability of this character of load is beyond question or argument. The question then arises, however, as to whether or not the central station can obtain this load. The answer depends almost entirely upon the answer to the economic question: Is the electric vehicle the most economical means that can be employed for the trackless transportation of merchandise within the radius of its legitimate application? If the answer to this question is in the affirmative, the central station will obtain this load.

We often hear the question, "If the electric vehicle is what it is claimed to be, why has not greater success resulted from the efforts to introduce it during the last ten years?" The answer is simple. No important industry has been 100 per cent successful from its birth. A large and important industry to be successful requires not only satisfactory working tools, but sufficient education to be used intelligently. Electric commercial vehicles manufactured from five to eight and nine years ago are today in successful operation. True, they are not as economical as the modern vehicles, but this could not be expected. Numerous other electric vehicles manufactured at the same time met a sad fate and have been the cause of much adverse criticism of this method of transportation. The reason for this difference in results obtained by different customers with the same article has been due primarily to lack of education. This is being rapidly corrected, which together with the improvements made in batteries and mechanical details, has greatly increased the usefulness and reliability of the vehicle.

The following tabulation presents important data, showing the improvement which has been made in the 1910 one-thousand-pound vehicle of a certain manufacturer over previous designs. Approximately the same relative improvement has been made on the other standard sizes.

COMPARATIVE DATA ON 1000-LB WAGONS

	Vehicle and Battery, 1906	Vehicle and Battery, 1910	Per Cent Change
Weight of wagon complete (approx.)	4500	3500	—22
Weight of battery	1400	1255	—10
Capacity of battery, ampere hours	112	138	+23
Capacity of battery, kw.-hours	9.2	12.1	+32
Ampere hours per pound	.08	.11	+38
Kw.-hours per pound	.00656	.00965	+47
Current required to run loaded wagon on level (amperes)	35	23	—34
Speed of wagon on level, miles per hour	10	12	+20
Battery discharged in hours	3	6	+100
Mileage possible on one charge	30	72	+140
Life of battery in miles (approx.)	7000	11000	+57
Cleaning required during life	3	0	..
Cost of each battery renewal	$327.00	$227.00	—30
Cost of cleaning per annum	120.00	0	..
Flushing with water, times per annum	100.00	25.00	—75

It will be seen from the above that the battery in the 1906 wagon was required to discharge at a three-hour rate, whereas in the 1910 wagon it is discharged at a six-hour rate, and that the 1906 wagon could barely run 30 miles on one charge, whereas the 1910 wagon can run 45, which is the guarantee, and have a good margin to spare.

The saving in weight has been accomplished chiefly by the adoption of a single motor, simplified transmission, lighter battery and high class steel, and not by sacrificing strength in the running gear or body.

The greater portion of the improvements indicated has been made since 1907. The modern electric wagon is a better hill climber and gives better service in every way than that of 1906, is speedy enough for traffic conditions, and has sufficient battery capacity to do a full day's work under average conditions.

The refinement of motor and control construction, the reduction of friction to a minimum, the improved mechanical design minimizing maintenance expense, the improved storage battery resulting in greatly increased capacity, longer life and reduced renewal expense combined with intelligent selling and intelligent operation has made the electrical commercial vehicle an economic success. One important example in evidence of this fact may be of interest.

One of the large brewers in New York City, the Peter Doelger Company, something over two years ago, was rabidly antagonistic to the electric vehicle because of involved experience with electric vehicles in the earlier days. As a result of continual effort they were at last induced to try a modern 5-ton truck. At the time of placing order for this truck they stated that if it would do what was claimed for it, in five months an additional order for five more would be placed. At the end of five months the additional order was received and a statement made that if these trucks gave the same satisfaction as the first one purchased, within six months an additional order for twelve would be placed. This company has recently placed an order for twelve 3½-ton and six 5-ton trucks and state without qualification that they will save at least $20,000 per year in cost of transporttation over their previous methods of horse-drawn vehicles.

The majority of vehicle orders today are repeat orders, a sure indication of satisfaction. We therefore have at hand an economical, satisfactory device.

The gasoline truck which is being rapidly introduced is really non-competitive with the electric, as each has its own respective field, but commercial activity is making the gasoline car a more and more important competitor of the electric in the commercial field properly belonging to the battery-driven vehicle.

3½-ton Truck going up Taylor St., between Pine and Bush St., San Francisco
Load, 6000 lbs.—Grade 16%

There has been one main objection to the electric vehicle which has been much discussed and on which definite information may be of interest. Many supporters of the electric vehicle have been more or less ready to concede that level street conditions were a necessity for its successful operation. It is perfectly true that an electric vehicle will not travel as many miles on one charge under conditions of severe grades as it will on a level—neither will a horse. Cincinnati is far from level, but many electric vehicles are operated there with eminently satisfactory results. Kansas City also has some extreme grades. The following letter received from the Duff & Repp Furniture Company of that city is illuminating:

"We take pleasure in handing you herewith our order for another two-ton truck, to be a duplicate of the one ordered by us last year.

"We are making 26 to 30 miles a day over the hills of our city with the truck, replacing five horses, and this order for a second machine is in consequence of the work done and our belief in the economy of your method of hauling. June 8, 1910."

The San Francisco Gas & Electric Company has been using a 3½ ton truck and a 1-ton truck under San Francisco's hill conditions for the past three months with mileage results eminently satisfactory.

Fig. 1 shows the effect of different grades on a 1-ton electric vehicle equipped with lead and with

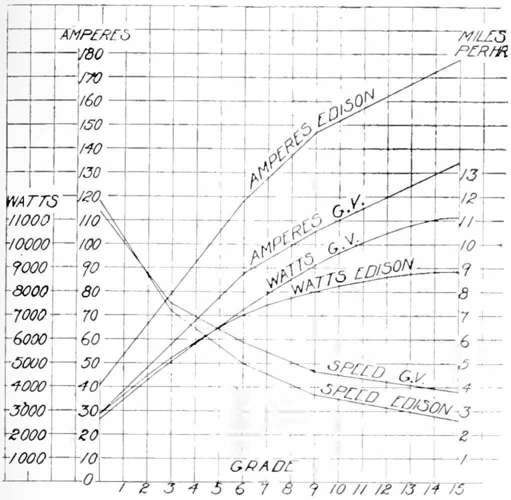


Fig. 1.

Edison batteries. Curves for other sizes would take about the same relative shape.

Fig. 2 shows curves of cost of operation per mile and per ton mile when various sized vehicles are operated the schedule of miles indicated. Cost figures include amortization at ten per cent of the original purchase price and interest on one-half the investment at six per cent. Interest is figured on one-half of the investment because the book value of the vehicle is being constantly written off. The cost figures of the curve also include liability and fire insurance, driver, garage rent, labor and maintenance and repairs of batteries, tires and vehicle, but does not include painting or repairs to woodwork. It includes current at 4c per kw. hour.

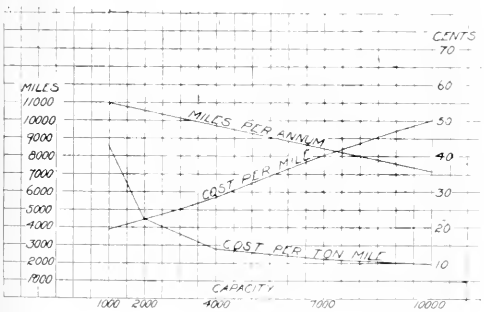


Fig. 2.

Should not electrical engineers while having the most ideal form of motive power at their command, seek to improve, standardize and cultivate its usefulness?

The electric vehicle of today is capable of doing a full day's city or suburban work on one charge of the storage battery with a margin to spare. It is probably not destined to compete with railroad transportation and we may concede for the present at any rate, that there is a large field for gasoline trucks where great distances have to be covered.

At a recent competitive test in New York City of various sizes of gasoline and electric trucks on transfer work it developed that the larger sizes of electric trucks operated at a power cost per ton mile of about one-half of the cost of the gasoline trucks. The current was figured at 4c per kw. hour, gasoline at 16c per gallon and lubricating oil at 50c per gallon. The smaller sizes of electric vehicles made practically the same showing in delivery service requiring many stops.

Requirements of modern business are becoming such that we are not merely facing the problem of a substitute for horses. There are many cases where it is more economical for the merchant to operate power vehicles even at a high cost per mile than to pack his goods for railroad transportation, and the radius of action of trackless delivery systems is, therefore, becoming extended far beyond the capabilities of horses and possibly of storage battery trucks. This fact in itself makes a field for gasoline trucks, and it is possible that the public are to some extent deceived in regard to the use of gasoline trucks which are seen on the streets of our cities.

As a matter of fact, they are used largely for long distance work and in relatively few cases have been bought to take the place of horse delivery systems, whereas the electric vehicles are actually being substituted for horses and have proved their ability to successfully compete in the cost of operation, at the same time possessing other advantages.

It is important that electric light companies and all manufacturers and dealers in electrical apparatus should not only advocate the electric vehicle but should deliver their goods with it, as every electric wagon on the street helps in creating a sentiment favorable to this form of motive power.

To add a profit bearing load at no appreciable increase in fixed charges is almost the utmost to be desired by the management of any central station. To do so at a very inconsiderable expense is almost ideal. The following table gives the earning power as compared with other current consuming devices the promotion of which has required considerable labor and expense.

ELECTRIC VEHICLES

Type of Vehicle	Estimated kw. hours average annual demand	Number of 550-watt arc lamps 4 hrs. daily, 300 days	Number of 50-watt incandescent lamps 1 hr. daily, 300 days	Number of flat irons 3 hrs. daily
5-ton truck	11,000	17	752	141
3½-ton truck	9,360	14	624	120
2-ton truck	7,440	11	496	95
2000-lb. wagon	5,520	9	368	70
1000-lb wagon	4,560	7	304	58

ESTIMATED ANNUAL KW. HOURS AVERAGE DEMAND OF INDIVIDUAL ELECTRIC VEHICLE COMPARED WITH THE NUMBER OF ARC LAMPS, INCANDESCENT LAMPS, OR FLAT IRONS OF EQUIVALENT KW. HOURS DEMAND.

The above tabulation is based on the demand 20 per cent less than the full capacity of the battery.

There are those enthusiasts who predict that within a decade a greater portion of the central station's output will be used for charging electric vehicles during non-peak hours than is furnished today for driv-

ing industrial motors. Such may or may not be the case, but here are 5 simple facts I wish to leave with you:

First. Within the sphere of its legitimate application, which includes 80 to 85 per cent of all trucking problems, the electric commercial vehicle is the most dependable, most satisfactory, most economical of all trackless vehicles.

Second. In a great percentage of the cases when a shipper has bought one modern electric vehicle for trial he has thereafter increased his equipment.

Third. Substantially all vehicles must be charged on central station current.

Fourth. Practically all charging is done at nonpeak hours.

Fifth. The annual kw. hour consumption of an electric vehicle makes it, even at a preferential rate, one of the most attractive sources of income obtainable in proportion to expense of handling the business.

ELECTRIC POWER CONSUMPTION FOR GOLD DREDGING.

BY L. ETTRUP.

Figs. 3 and 4 on page 161 of the Journal of Electricity, Power and Gas, of Feb. 18, 1911, are test diagrams taken from the Marysville Company's dredger at Marysville and from the Ashburton Mining Company's dredge at Folsom. The tests were made under the writer's directions by Mr. S. G. Gassaway.

As the tests were only taken to determine what size motor to install on a new dredge under construction they must not be considered as giving an exact diagram of the work done by the motor, but only an idea of the horsepower used and the variation in load.

The following motors are as a rule used in gold dredging:

One digging motor of from 75 to 300 h.p., 3-phase variable speed (360 r.p.m. or 600 r.p.m.) usually 14 notch controllers either to be run constantly on all points or a limited time on the first 7 and any length of time on the last 7 points. The duty of this motor is to drive an endless bucket chain at a speed of from 16 to 24 buckets per minute, or from 50 to about 70 feet digging speed. By examining the h.p. curve you will find that the greatest power is used to drive the empty machinery, and you will notice that it takes more power to drive the bucket line empty in a nearly horizontal position than it does in several positions at certain depths where the ground is soft. This must be due to the fact that when the digging ladder is horizontal the full weight of the bucket line is on rollers and tumblers and as the bucket line's weight is from 50 to 100 tons a considerable amount of friction is created. When the digging ladder is on an angle only a component of the weight creates a friction on the rollers that support the bucket line. Dredgers are as a rule supplied with bigger motors than are really necessary as they are subject to variable loads. The variable speed motors are many times thrown from the 14 point ahead to reverse.

The winch motor is from 20 h.p. to about 35 h.p. 3-phase variable speed and as a rule 600 r.p.m. The duty of this motor is to swing the dredger, hoist spuds and stacker and, if head line is used to dig on, it will also have to handle that line.

The pumps are driven either by one motor directly connected to two pumps or by two motors each directly connected to a pump. The size of the first motor varies from about 75 h.p. up to 100 h.p. On the second arrangement one motor usually from 35 to 50 h.p. and the other as a rule 50 to 100 h.p. all depending on the capacity of the dredge. These motors are 3-phase, about 900 r.p.m. constant speed.

One stacker motor is used to drive a conveyor belt. This motor, in the medium size dredger, is of about 35 h.p. capacity, 600 to 900 r.p.m. 3-phase, constant speed.

One screen motor is used to drive shaker or a revolving screen. This motor is usually from 25 to 35 h.p., from 600 to 900 r.p.m. of the constant speed, 3-phase type. When magnetic friction clutches are used a motor generator set is employed to generate direct current for the clutches.

ELECTRIC POWER FOR GOLD DREDGING.

BY S. G. GASSAWAY.

In California, there are now about 130 gold dredges operating as follows:

Fifteen at Hammonton on the Yuba, 30 at Oroville, 9 at Folsom, 75 scattered in counties of Calaveras, Merced, Siskiyou, Shasta, Stanislaus and Trinity. Their combined yield is about $8,000,000 per year in gold.

Dredges capable of handling 250,000 cu. yds. per month are now built at a cost of from $180,000 to $200,000, the capacity of the buckets being 13½ cu. ft. As dredges grow in size the cost and difficulties of handling the large current, corresponding to the larger amounts of power required, increase, and so higher operating voltages are used, the latter dredges employing motors wound for 2300 volts instead of 220 or 440 as formerly. This increase in voltage is especially desirable if power is transmitted at 2300 volts, as it eliminates the dredge transformers, thus not only saving their first cost and power losses, but also making one less link connecting the dredge motor to the source of power, thus avoiding possible shut-downs due to transformer trouble. With 2300 volt motors the wiring of the dredge is simpler and considerably cheaper in first cost and installation as it is possible to use triple conductor cables. A number of dredges are now operating with 2300 volt motors.

Original dredges were operated by steam, then direct current and alternating current were both tried, the a.c. finally winning out as the most suitable. One dredge, however, which was built as late as 1908, is equipped with d.c. motors on the bucket line and winch and a.c. on other parts. Alternating current is purchased and converted to d.c. with rotary converter. This, however, has not proven satisfactory nor economical and I understand the d.c. motors are to be replaced by variable speed a.c.

One dredge recently built is provided with a synchronous motor to drive the pumps and is of sufficient capacity to operate with sufficient excess field excitation to supply the wattless current taken by the induc-

tion motors, thus relieving the station generators besides effecting a considerable saving in the power bill because of reduced line loss.

A device used on several dredges whuch has saved many dollars is a magnetic clutch on the bucket drive. This clutch is operated by direct current supplied by a small motor generator set of about 1 kw. capacity. The winchman can set the clutch to slip at any value he desires by adjusting a rheostat in series therewith. In this way the strain on the bucket line, tumblers and gears is limited. Without the clutch, should the bucket line strike a boulder or other obstruction, something is liable to break, causing shutdown. Upon striking an obstruction, the clutch slips whenever the strain exceeds the predetermined amount, this oftentimes preventing breakage and shut-down.

APPLICATION OF ELECTRICITY TO ROCK DRILLS AND DRILLING.

BY J. W. WHITE.

One conspicuous exception to the general use of electricity has been in the excavation of rock. The combination of the ruggedness of the air or steam drill with the high efficiency, flexibility and economy of electricity has long been sought and, despite many failures, a firm conviction that it would some day be realized has been generally held.

The early developments in the field of rock drilling were along the lines of least resistance, and as electricity and its application was but little known at that time, steam and air were applied because they were the easiest handled, and there was more known about their characteristics than any other two methods of applying power to machinery of this nature.

Steam was early discarded where the power was to be transmitted over any great distance, on account of rapid condensation, due to cooling, and consequent loss in power. On the other hand, wherever a steam boiler could be placed near the drills, the cost for the equipment was much less, and was a more direct application than by applying the same power to an engine, which in turn drove an air compressor to operate the same drill. For the purposes of this discussion, therefore, the operation of drills by steam may be neglected on account of the limited distance through which it can be transmitted with economy.

It is well known that the energy transformation in the use of compressed air is not high, but the fact "that it does things," some of them better than by any other means, and some which are not otherwise done, has made the matter of fuel economy of secondary importance. Therefore, no apology is needed for the use of compressed air today.

It is a well known fact, however, that air does work, and this may be compared to the compressor work, "although they have no direct relation," and in this way an efficiency may be obtained.

Types of Air Drills.

Drills may be classified as core drills, well drills, reciprocating drills and hammer drills.

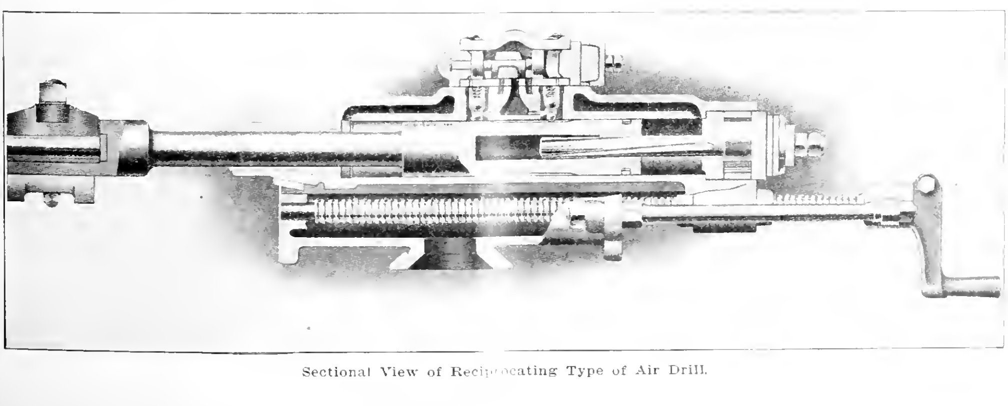
The core drill is of the rotating type, in which a core of rock is cut from the main body and drawn up with the drill. For this operation a shell is used, which in turning cuts the core free. Some types of drills employ diamonds set in the cutting edge and are known as the diamond drill. Other types have an actual cutting edge of their own, or are fed with steel shot to assist the drill in cutting the rock.

The well drill is of the familiar type used for oil well drilling or for prospecting ore-bearing ground, and its principal operation consists in raising and dropping a hammer, depending upon the impact of the blow thus given to force the drill point through the strata to be penetrated.

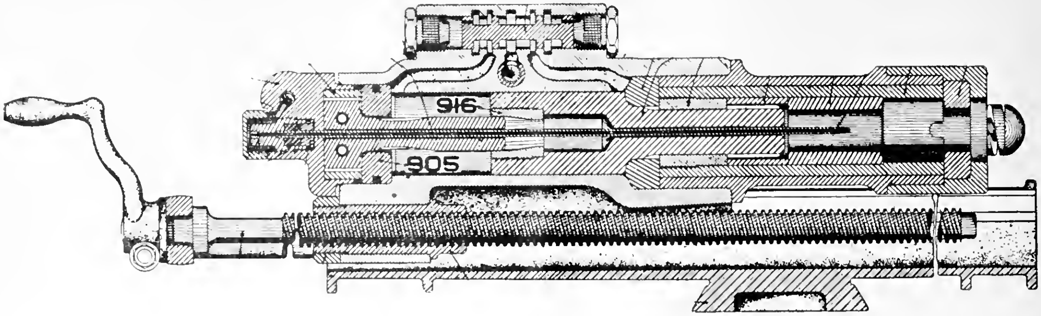
The reciprocating drill is distinguished by the fact that it has a piston, which is reciprocated by means of admitting air to either side of same, this admission being under the control of a sliding valve. In this type of drill, the steel is fastened rigidly to the piston, and the blow is given to the rock by virtue of the moving weight and its consequent velocity.

In the hammer drill a floating piston is used, which travels the length of the cylinder, due to admission of air or steam through a valve controlled port similar to the reciprocating drill. The one exception being that in the latter instance the piston is also the hammer, and delivers its blow directly to a drill steel cap at one end of the stroke which in turn directly transmits the force to the head of the drill steel.

As the application of electricity to core drills is limited only by the convenience of electric power in the territory in which operations are to be conducted, the application of electricity to this type of drill is not an important matter in this discussion.



Sectional View of Reciprocating Type of Air Drill.



Sectional View of Hammer Type of Air Drill.

In the case of the well drill, this problem has already been solved, and in other papers presented this evening the subject will doubtless be given considerable attention in connection with the drilling of oil wells.

The greatest difficulty therefore, has been in the application of electricity to drills of the reciprocating and hammer types, and with which this paper is directly concerned.

Exhaustive tests on reciprocating drills show that the combined efficiency of the drill, compressor and prime mover average between 20 and 30 per cent. This percentage varying in accordance with the type of air compressor, drill and prime mover, and while this efficiency is manifestly low from the view point of the layman, upon careful investigation it will be found that the losses in the compressor, transmission system and in the drill itself fully account for the inefficient result above given.

For instance: A 3 in. air drill of the reciprocating type when operating at 80 lb. pressure takes approximately 114 cu. ft. of free air, and with two stage compression it takes approximately .146 h.p. per cu. ft. when due allowances have been made for transmission losses, or a total of 16.7 h.p., while the indicated horsepower of a drill of this type is approximately 4.8 giving an efficiency of 28.8 per cent for a complete installation. These figures are often modified by elevation and exising conditions, as well as type of prime mover.

The hammer drill is the latest development in rock drill practice, and at the present time is still somewhat in the experimental stage. This type of drill has certain applications for which it is adapted, and which will be taken up later.

The efficiency of the drill is somewhat higher than a piston drill, due to the fact that with a smaller moving element the friction loss of the drill itself is reduced to a minimum, and for the same size as the reciprocating drill, the efficiency will be probably about 5 to 8 per cent better. This type of drill also has the added advantage that the drill steel is not reciprocated. In other words the blow is struck directly on the head of the drill steel, while the drill point is kept against the face of the hole continually. It is evident that a great deal of the power taken by the piston or reciprocating type of drill is lost by the friction of the moving drill bar in the hole, and consequently for the same amount of work done, the hammer type of drill takes about one-third less air, or about 11 h.p. per drill. In comparison with a 3 in. drill of the reciprocating type, which drill will consume about 16.7 h.p.

It should be noted here that the efficiency of the drill is entirely foreign to the footage of rock drilled and should not be confused with it. The amount of rock drilled depends on other factors in addition to the power applied as will be shown later.

In small drills of the hammer type no water is used in drilling, consequently their application is limited to uppers and holes above the horizontal. Therefore, machines of this type are made in small sizes for work in small stopes, headings, etc., and are of such weight that they can be handled by one man.

These drills are not applicable for drilling horizontal or down holes, on account of the fact that they will not clear, and consequently stick, all turning of the drill steel being manual. In the large sizes, common practice is to carry water to the point of the drill by means of the hole in the center of the drill bar. With this type of drill it is possible to drill both uppers, horizontals and down holes, although the greatest difficulty is met on the vertical down holes.

Coming now to the question of application of drills to different kinds of work, it has been found that hardly any type of air drill at present on the market is satisfactory for all work.

For instance: The piston or reciprocating drill will work on down holes and uppers, but is at its greatest disadvantage on horizontal holes on account of the fact that it is impossible to get water into them, and they will not clear themselves as well as uppers. On the other hand, the hammer type of drill in the small sizes is successful on uppers wherein the clearance feature does not effect their operation, but they are limited to this one class of work on this account.

The large hammer drills which use water are good on uppers and horizontal holes, but experience considerable trouble in clearing on down holes where the muck is liable to clog the drill and thus assist in deadening the rebound, so that in turning the drill wears itself away on the face of the hole.

Both of these types of drill use crossbit steel and some of the hammer drills use a five pointed steel. Experience has shown that the hammer type of drill at present has the highest maintenance cost, although their work is much more rapid. On the other hand it is more satisfactory in broken ground, as the drill does not plunge ahead into crevices like the reciprocating drill. At the present stage of development, the

piston drill holds the advantage over the hammer drill in the cost of excavation per foot, although it is quite probable that the hammer drill actually drills faster than the piston type, but is much more complicated, and if the expense incurred by the fact of its being out of commission were added to the maintenance, the probable cost per foot of ground broken would be considerably in favor of the piston machine. It is quite probable however, that the new improvements along the line of air drilling are mostly in the hammer type of machines.

The Electric Drill.

With the above brief history of air machine work, we can take up the development of the electric drill. It has long been realized that the successful application of electric power to rock drilling would result in a much greater economy and give a lower first cost of installation as well as being more flexible on account of portability of individual units.

With the air machine it is necessary to have a compressor of sufficient capacity to handle the number of drills operated, and it is needless to say that the standby losses when only a portion of the equipment is in operation are considerable. It is also necessary to buy a large machine for the initial installation, (which the customer is often not warranted in purchasing), simply because he expects to put in more drills at a later date.

The cost of running pipe lines, etc., is a considerable item, and the losses in air transmission are at least three times as great as in electrical application.

The first style of electric drill designed was of the solenoid type, using two opposed solenoids and an alternating current generator of very low frequency, the number of blows struck being equal to the frequency of the generator. It is needless to state that the efficiency of solenoid operation is not of the best and the reciprocating action made a wreck of a seemingly simple design. The greatest fault with this type of drill was that the greatest moment exerted upon the drill steel was at the beginning of the stroke, and as the core entered the solenoid, the magnet pull fell off appreciably so that at the end of the stroke the drill was receiving practically no energy from the solenoids. On this account it was necessary for the drill runner to give the drill considerable attention, as the blow depended upon the position of the solenoid core at the time the blow was struck.

Another early design used a motor which compressed a spring on the return stroke of the drill, tripping it with a trigger at the proper time so that the impact to the drill steel was delivered by this spring in expanding.

This type, like the first, is at a disadvantage because the effect of the spring is least at the end of the stroke, therefore, the impact of the blow is dependent upon the velocity of the reciprocating part gained on the first portion of the stroke. A great deal of trouble was experienced with the springs and in the lubrication of the drill, while the drill itself was of such a weight that it was bulky to handle.

Another development following this was of a drill electrically driven, but operated by compressed air. A small motor was direct geared to a double acting compressor, which contained but two inlet valves, and which was connected by flexible pipe to a standard air machine, which also was equipped without valves. In this drill, the piston was moved back and forth by the transmission of pressure from the pistons of the air compressor, and this was the first practical electrically operated drill (if it can be called such).

With this machine it is possible to do the same work with about 5 h.p. that the reciprocating air machine does with 16.7 h.p.; a saving of 11.7 h.p.

This drill is still upon the market and is successful in places where it is possible to carry the compressor with the drill, as it is necessary to have the length of hose between the compressor and the drill as short as possible, in fact, within 7 to 10 ft. It is therefore, impractical to use them in shafts or in small stopes, and their work is limitel to open quarries and faces of tunnels where the compressor can be pushed back when the charges are fired.

The compressor and motor on these drills weighs in the neighborhood of 900 lb. and the complete equipment approximately 1200 lb. It is therefore, apparent that while these drills will be successful in certain classes of work, their field is limited.

The next development in electric drills was what is known as the air-electric, in which a piston is operated through a scotch yoke (or an ordinary crank) and gears by a motor. The motor being mounted upon the guide shell of the drill. The drill itself is entirely separate from the piston already mentioned and is operated by an air medium. By combining the motor and drill upon the guide shell, much weight was avoided, but it is all concentrated in the drill itself, making it bulky to handle, either upon a tripod or a standard.

These last two drills were open to the same fault as all others of the electric drills in the past, that is that the least amount of energy was being transmitted to the piston at the end of the stroke, on account of the crank passing a dead center.

In addition to this the question of lubrication, the difficulty experienced in changing rotary to reciprocating action, made the upkeep of this latter drill prohibitive, and as far as it is known they are not in general use at the present time. One of the later drills used the same principle but instead of having a motor driven piston, the cylinder wall was reciprocated, thus changing the valve action, so that the same effect was produced through ports.

With this type of drill it was claimed that a 4 h.p. motor would do the same work as a 3 in. reciprocating air machine, but as this has never been generally proven, its operation over a wide range of conditions and a long period of time makes this guarantee a matter of conjecture.

The types of electric drills just mentioned constitute most of the attempts to produce a successful reciprocating drill, and most of the later designs are using the hammer principle.

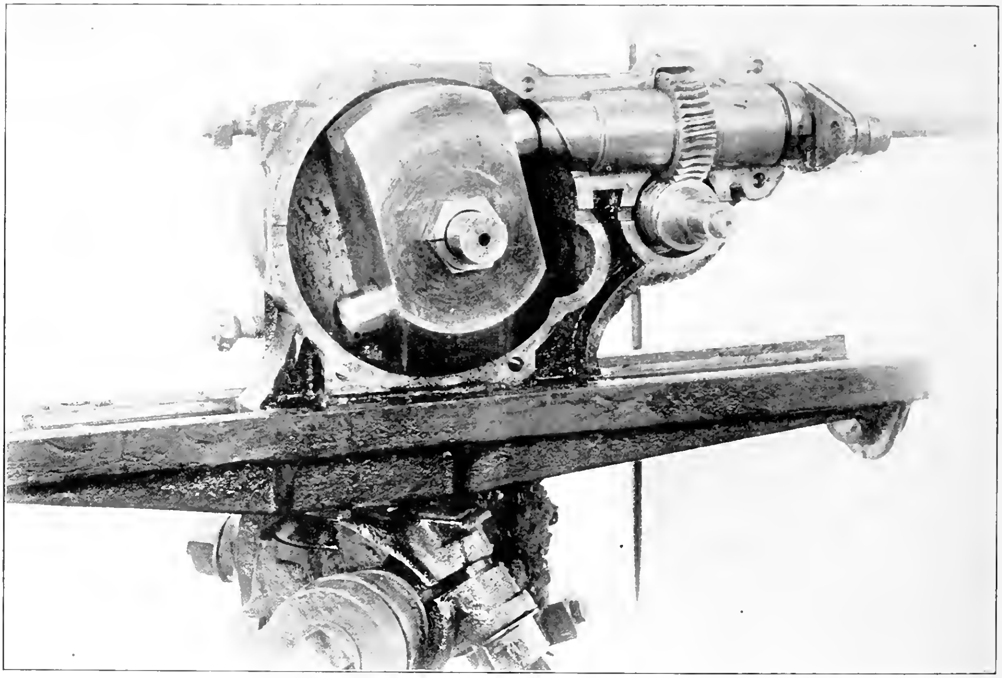
One of the latest drills of this design is an air-electric drill, similar to the reciprocating drill previously mentioned, except that as in all hammer types of drills, there is a floating piston only, which delivers its blow to a stationary drill bar.

This type of drill will be probably much more successful than the air-electric reciprocating drill, but its

operations has shown that it is open to the same objection as the other electric drills, i. e., since it is operated by a crank which slows down as it approaches the dead center at the extreme end of the stroke, the striking mechanism is not designed to get the most efficient results. The striking hammer should be at its maximum velocity when it strikes the drill steel. In order to overcome this feature it is necessary to employ springs or an air cushion so as to accelerate the hammer and to compensate for the decreased speed of the piston at the end of its stroke. The air pad of course, acts as a flexible connection between piston and striking hammer.

At the present time electric drills have been developed to a point where they give from 50 to 70 per cent efficiency including electric losses, and due to certain principles of design, it is possible at the present time to do the same work with an electric drill with one-tenth the power, that is consumed by the air machine of reciprocating type.

The small amount of power taken is not due to the efficiency of the drill alone, but in great measure to the manner in which the blow is struck. Experience has shown that the drilling effect is directly proportional to the impact of the blow multiplied by the number of blows in a given time, and that over wide variation in the number of blows and the impact of them the amount of rock drilled is about the same. On the other hand the lighter blow gives longer life to the drill steel, and in doing away with the reciprocating type of drill a great deal of energy is saved on account of losses incurred by the drill bar in the hole itself.



Sectional View of Hammer Type of Electric Drill.

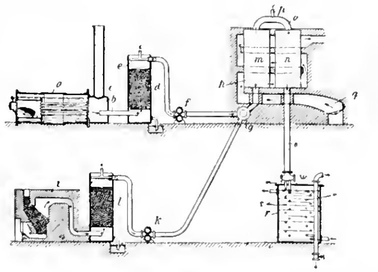
Of late there has been another type of electric drill placed upon the market, in which there is no change from rotary to a reciprocating motion in the striking mechanism. In this drill there is a rotating helve or hammer block which gives a fly wheel effect, and in periphery of which are seated two striking hammers. This helve is driven by a motor mounted on the guide shell by a belt, and as the helve rotates the hammers fly out by centrifugal force delivering their blow upon the drill cap and cushioning upon the trapped air in the chamber behind the hammer.

In addition to this the steel is given a positive turning motion, and the drill steel has a forged spiral wing which acts as a conveyor to bring out the cuttings. In this drill the maximum velocity of the hammer is attained at the instant of striking and gives the most direct application of imparted energy to the drill steel. This drill is the nearest to the hand method of "single-jacking" which has yet been devised, and its operation will be watched with considerable interest.

It is problematical whether a drill will ever be designed which will operate as well under all conditions as a drill designed for one class of work only, but to successfully design an electric drill, it is necessary to get away from reciprocating action, to mechanically turn the drill so that each blow will be in virgin rock and provide a suitable method of clearing the hole so the drill will not stick. The present trend of development appears to be along the line of hammer drills and from present indications the time is not far distant when electric drills will take the place of the large air machine drills, although it is quite probable that the small air stoping drills will be used for a few years to come.

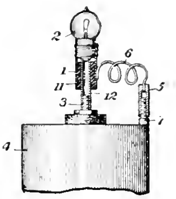
PATENTS

984,605. Method of Producing Nitrogen and Carbon Dioxid from Gaseous Products of Combustion. Max Reichel and Heinrich Braun, Berlin, Germany, assignors to Nitrogen-Gesellschaft, M. B. H., Berlin, Germany. The herein described



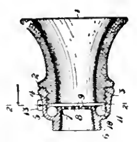
method of producing nitrogen and carbonic acid from ordinary products of combustion, which consists in mixing therewith a gas having a reducing action, passing the mixture thus produced in contact with hot copper and copper oxid, and separating the water, the carbonic acid and the nitrogen.

985,018. Battery Lamp-Socket. George N. Eastman, Riverside, Cal., assignor, by mesne assignments, to Eugene C. Brown, Washington, D. C. In an article of the class described a tubular metal casing having a lamp-base receiving means at one extremity and forming a contact for one of the



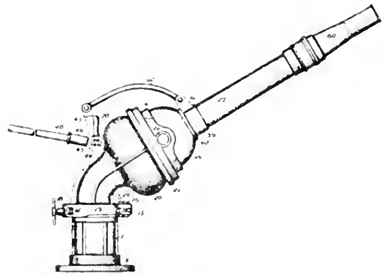
lamp terminals, an inner combined support and terminal member having means for attachment to a contact terminal an intermediate insulating bushing within said outer casing and having a contact projecting centrally therefrom to engage a lamp terminal, an auxiliary terminal connector external to said casing and a flexible conductor connecting said auxiliary connector and one of the lamp contacts.

985,021. Antiseptic Telephone-Mouthpiece. William M. English, Sausalito, and Louis E. Boukofsky and Solomon M.



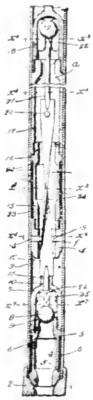
Lichenstein, San Francisco, Cal. In a combination with a telephone mouthpiece, a holder secured to said mouthpiece and having formed integral therewith an outer wall and an inner cylindrical wall, spaced from the outer wall or casing of the holder to form an annular recess, the edge of said inner wall being spaced from the mouthpiece adapted to contain absorbent material, substantially as described.

984,557. High-Pressure Nozzle. Henry H. Gorter, San Francisco, Cal. In a high pressure nozzle, the combination of a tubular outer portion formed in its inner surface with a lower run-way for balls, a nozzle, a sleeve within said outer portion, carrying the nozzle, a ring secured upon the lower



end of said sleeve, a ring of balls between said ring and run-way, said sleeve having at its upper end a flange, and rollers carried by said flange, bearing against the side of said tubular portion adjacent to the nozzle, the axis of said rollers being parallel with the axis of the sleeve, substantially as described.

985,052. Oil-Well Pump. Marshall J. Morton, Los Angeles, Cal., assignor of one-half to James I. Wagy, Los Angeles, Cal. An oil-well pump provided with a plunger and outside snap packing rings outside of the plunger body and outside



of the sanding valve, and provided with an automatic sand agitator to keep the sand loose within the plunger, said agitator being arranged to engage the valves of the plunger and standing valve to prevent the same from sticking.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
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CONTENTS

Electric Drive

Fifteen years ago, after electric drive had supplanted the steam engine or water-wheel as the prime mover in industrial works, when the change was one not so much a matter of operative expense as of expediency, engineers and prophets began drawing on their ingenuity and imagination to widen the field of its usefulness, and to give the electric motor an industrial individuality in addition to its position as an improved substitute. The idea, once started, opened a vista of opportunity, not only in the application of electric drive, but in making possible lines of industry heretofore not considered possible. The usefulness has therefore been two-fold, in that new industries have been thus created. It has been like the development of ordnance; a gun is invented which will drive a projectile through any known armor, which is immediately followed by a development in armor plate that will resist the shot and then the cycle is repeated again and again.

In the West where gold in relatively small quantities has been found in the gravel of the river deltas, the comparatively new dredge mining has grown to a giant industry. It is true dredge mining is carried on where steam power only is available, but the simplification of the electric equipment and the low cost of upkeep and operation, has made possible the profitable working of many gravel beds which otherwise might never have been touched.

Other industries have required the utmost skill and operative ability to be made adaptable to electric drive, which after installation soon proves its efficiency. In this connection pumping in small units for irrigation and use in the oil well industry are interesting. In the first case the motor must compete with gasoline power which need be only periodically used; and in the latter case oil fuel at low cost or free is an obstacle which appeals readily to the imagination of the power user.

The electric vehicle industry is limited, not by its electric drive, which is ideal, but by its intermittent connection with the source of power and the necessity of carrying storage batteries.

Electric drive for rock drilling has been a problem the benefits of which have long been apparent to engineers and miners. But the problem has been one of mechanical application signalized by many failures. It looks now as if the long sought for goal is at hand and a new era commenced in the rapidity and low cost of rock excavation.

Still another and very different use, which, now that it has been created, is indispensable to our daily domestic life and happiness, is the vacuum cleaner. A decade ago it was not economically possible, today no public building or hotel is considered sanitarily clean without it. Perhaps the broadest application of electric drive, created from its possibilities, but most affecting human comfort has been the development of the electric fan. The industry of manufacturing fans of every description and for all purposes has grown to great proportions.

PERSONALS.

Charles C. Moore of Charles C. Moore & Co., engineers, has gone to New York City.

H. F. Nanenz, an electrical contractor of Santa Cruz, was a recent San Francisco visitor.

Thomas Mirk, of Hunt, Mirk & Co., left for San Diego on engineering business last Monday.

S. N. Griffith, an electric railway builder of Fresno, recently spent a few days at San Francisco.

S. K. Colby, of Pierson, Roeding & Co., has returned to San Francisco after a trip to Puget Sound.

C. R. Ray, president of the Rogue River Electric Company of Medford, Ore., is visiting Los Angeles.

W. S. Heger, the California manager of the Allis-Chalmers Company, spent the past week at his Los Angeles office.

George H. Parker, manager of the United Wireless Telegraph Company's Seattle office, was a recent arrival at San Francisco.

Otto E. Osthoff, one of the vice-presidents of H. M. Byllesby & Co., of Chicago, arrived at San Francisco during the past week.

John Martin, who is interested in the Coast Counties Electric Power Company, has returned to San Francisco after an Eastern trip.

W. J. G. Lambert, one of the original promoters of the Home Telephone Company, arrived at San Francisco from Los Angeles last Saturday.

M. S. Hopkins, of the Clark Syndicate, which owns the Portland Railway, Light & Power Company, of Portland, Oregon, is a San Francisco visitor.

C. H. Bennett, manager of the operating department of the Pacific Electric Railway of Los Angeles has been spending a few days at San Francisco.

H. M. Winter has resigned as manager of the Seattle office of the General Electric Company to become general manager of the Seattle Electric Company.

C. E. Grosbeck, one of the vice-presidents of H. M. Byllesby & Co., with headquarters at Portland, returned last week from a trip to Japan and China.

Roy C. Wolden, general manager of the California Electrical Construction Company, recently returned to the San Francisco branch, after a month's absence in the East.

Thomas E. Collins, of the sales department of the Westinghouse Electric and Manufacturing Company, has returned to the San Francisco office after an Eastern tour of six weeks.

G. R. Field, assistant general manager of the Great Western Power Company, left last Monday for a trip covering the hydroelectric transmission system between Oakland and Big Bend.

C. M. Bliven, sales agent of the General Electric Company at San Francisco, has been made manager of this company's office at Seattle, Wash. He has been succeeded at San Francisco by Wm. M. Shepard.

W. G. B. Euler, superintendent of the Big Bend division of the Great Western Power Company, has returned to the hydroelectric plant on the Feather River, after spending a month's vacation in Southern California.

Wynn Meredith, manager of Sanderson & Porter's Pacific Coast branch office, spent the past week in Southern California, visiting among other places the manufacturing plant of the Pacific Electric Heating Company at Ontario.

E. A. Klose, who was formerly with the Mutual Electric Light Company, is now chief engineer of the South Side Light and Power Company's new steam-turbine power station on Minna street, near New Montgomery, San Francisco.

A. J. Churchill, president, and A. J. Rosborough, secretary, of the Yreka Electric Power and Light Company, have returned to Yreka, after spending a week at San Francisco in conference with their engineers, F. G. Baum & Co., regarding plans for extensions of their hydroelectric system.

Geo. S. Nickerson and Carl Maughmer have opened offices as civil and hydraulic engineers in the Ochsner Bldg., Sacramento, Cal. Mr. Nickerson has just finished the construction of a concrete steel bridge at Winnemucca, Nev., and Mr. Maughmer is assistant State engineer of California.

S. G. Gassaway has resigned from the engineering department of the General Electric Company at San Francisco to accept a position with the Kern River Oil Fields, Ltd., at Bakersfield. This company will install a large number of General Electric motors for oil well rigs, etc. H. C. Stanley succeeds Mr. Gassaway with the General Electric Company.

LOS ANGELES ELECTRICAL LUNCH CLUB.

The next regular monthly meeting of the Electrical Lunch Club of Los Angeles will be held Thursday, March 9, at the Hollenbeck Hotel. Mr. Geo. A. Damon of the Bion J. Arnold Co., will speak on "Transportation." All electrical men in the vicinity at this time are invited to attend.

TRADE NOTES.

The Bowers Rubber Company have decided to substitute electric power for the present steam installation at their Bay Point (Cal.) factory, contracting for about 500 h.p. from the Great Western Power Company.

George A. Johnston of Los Angeles, Cal., has moved his office to 551 South Los Angeles street, where he will continue to act as sub-agent for the Wagner line of alternating current motors, generators, transformers and instruments.

The Natomas Consolidated of California, Marysville, Cal., has ordered about 1000 h.p. in motors from the Westinghouse Electric & Mfg. Company, Pittsburg, Pa. The motors will be used in operating a gold dredge. It is interesting to note that the use of 2200 volts direct on the motors has proved successful on a electric dredge that the company already has in operation and that the new motors will operate on the same voltage.

The General Electric Company has sold to the Los Angeles Railway Company two motor generator sets described as follows: One 2-bearing set consisting of I. 12, 1400 h.p., 500 r.p.m., 2200 v., form K, induction motor, direct connected to an M. P. C. 8, 1000-kw., 600-v., compound wound generator. One 3-bearing set consisting of an I. 8, 900 h.p., 750 r.p.m., 2200 v., induction motor, direct connected to an M. P. C. 6, 600 kw., 600 v., compound wound generator.

The General Electric Company reports the following contracts closed for electrical equipment: To the San Francisco Gas & Electric Company for use at San Francisco, a 15,000 kw. steam turbine rated as follows: One A. T. B. 10, 15,000 kw. (18,750 k.v.a. 8-10ths p.f.) 720 r.p.m, 11,000 v., vertical Curtis turbine generating set with condenser base; for use at Sacramento a 12,000 kw. steam turbine as follows: One A. T. B. 10, 12,000 kw. (15,000 k.v.a., 8-10ths p.f.), 720 r.p.m., 4150 v., vertical Curtis steam turbine generating set, with condenser base; and for installation at San Rafael, one A. T. B. 4, 5000 kw. (6250 k.v.a., 8-10ths p.f.), 1800 r.p.m, 4150 v., horizontal condensing steam turbine generating set.

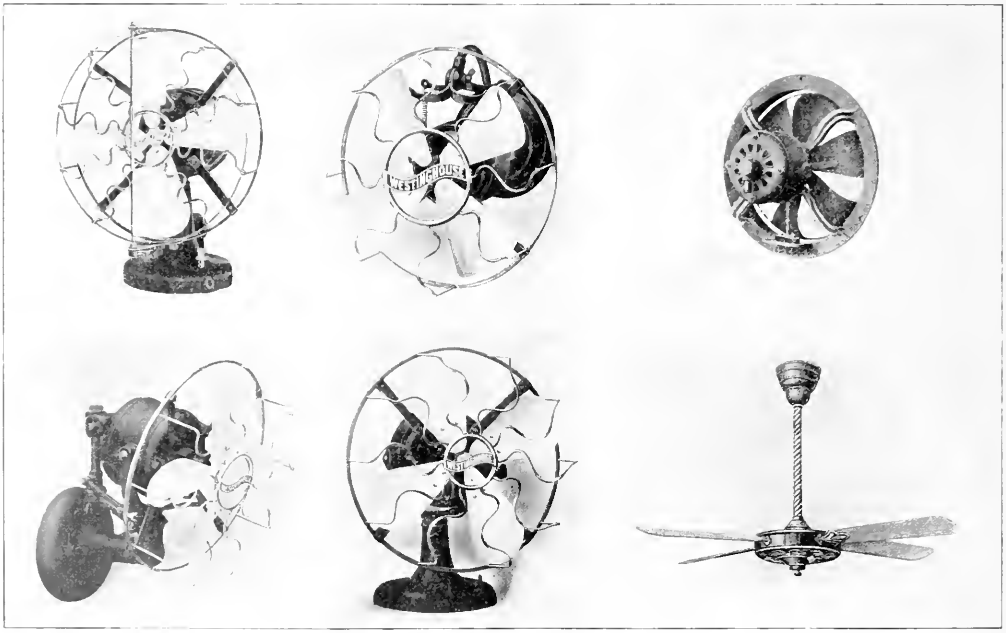
INDUSTRIAL

WESTINGHOUSE FANS FOR 1911.

The 1911 line of fan motors of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., includes all of the types furnished in 1910 with the addition of several new designs. The fans built by this company now include alternating and direct current fan motors for all purposes; desk and bracket fan motors of the swivel-and-trunnion, mechanically-operated oscillating and air-operated oscillating types with 12 in. and 16 in. blades; 12 in. six-blade residence type fan motors; 8 in. desk and bracket fan motors; 8 in. telephone booth fan motors; a complete line of ceiling, counter column and floor column fan motors; and 12 in. and 16 in. exhaust fan motors with either Westinghouse standard or Blackman blades. The alternating current fan motors are designed for 25-30, 40, 50, 60 and 133 cycles, 110 or 220 volts; the direct current fan motors are designed for 30, 50, 110 or 220 volts, except the ceiling and column types which are not built for the battery voltages.

The 12 in. and 16 in. desk and bracket swivel-and-trunnion fan motors are adjustable through a wide angle and are clamped firmly in any position. An adapter is furnished for bracket use, which can be inserted between the motor body and the base without opening the circuit.

The 12 in. and 16 in. mechanically operated oscillating fan motors are an addition to the Westinghouse line. The fan is of the same construction as the swivel-and-trunnion type, having a wide adjustment above and below the horizontal. The oscillator mechanism consists of a double worm reduction and a single oscillating lever. The gears are enclosed in a case packed with grease. The arc of oscillation is adjustable within 90 degrees. These fans can be quickly arranged for wall mounting by means of an adapter similar to that used with the swivel-and-trunnion fans.



Westinghouse Fans for 1911

The aim in the design of the Westinghouse fan motors has always been quality. The alternating current motors are designed for high power factor and high efficiency. With the exception of the 8 in. types these are induction motors starting on the split phase principle. In the desk and bracket types the starting winding is automatically cut out by means of an efficient switch when the motor attains speed. The direct current motors and the 8 in. alternating current motors are designed for high efficiency and sparkless commutation. The armature cores are built of laminated steel with the coils enclosed in slots, and the wall designed commutators and rectangular brushes prevent operating troubles. Most of the fans are lubricated by grease cups feeding through wicks, and the ceiling fans have in addition ball bearings.

Air operated oscillating fan motors are still furnished in 12 in. and 16 in. sizes for use where oscillation in the horizontal plane is sufficient. The angle of oscillation is adjustable by means of movable stops, in 30 degree steps. If desired the stops can be removed and the fan allowed to revolve continuously. The use of contact rings to conduct the current to the motor makes this possible. A substantial bracket is furnished for wall mounting.

The Westinghouse 12 in. residence fan motors are particularly applicable for hospitals, libraries, sleeping rooms or other places where quiet is essential. The fans operate at low speed but have six blades set at a high pitch instead of four. Otherwise they are the same as the desk and bracket types.

The 8 in. desk bracket fan motors have become very popular for use where the strong breeze of a large fan is undesirable. The bodies and bases of these motors are of pressed sheet metal, finished in black oxide, mottled copper,

polished brass or brushed brass, and present a very attractive appearance. The 60-cycle, 110-volt motors of this type can be used with a special converting base on 25 to 50 cycles or on direct current of the same voltage A swivel arrangement in the base makes it possible to mount the fan either in a vertical position or on the wall, and makes vertical angular adjustment possible.

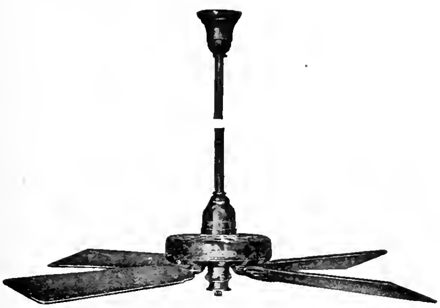
The 8 in. telephone booth fan is identical with the 8 in. desk and bracket type, except that the motor body is suspended from a bracket by four springs which prevent vibrations being transmitted to the telephone.

The Westinghouse ceiling and column fan motors have in past years demonstrated their dependability, and their success where the distribution of a moderate breeze over a wide area is desired, has been gratifying to both the manufacturers and customers. The alternating current fans are built with 56-inch blade sweep, one-speed fans finished in black japan and three-speed fans finished in mottled copper. The direct current fans are built in 32 in., 54 in. and 57 in. sizes, with various finishes. Ceiling fans and column fans are identical except for the method of mounting, and in general column fans are used where the height of the ceiling will not permit the use of the ceiling type. The counter column fan motors have 36 to 48 in. clearance between blades and base, and floor column fans about 7 ft. All of these fans have substantial blades of hard wood with mahogany finish.

An addition to the Westinghouse line is a design of 12 in. and 16 in. exhaust fans with Blackman blades. These fan motors are furnished with six blades of a special shape designed to operate efficiently against pressure. The slow speed enables these fans to exhaust with a minimum of noise. Either standard blades or Blackman blades can be furnished with the exhaust fan motors.

G. E. FAN MOTOR MODELS FOR 1911.

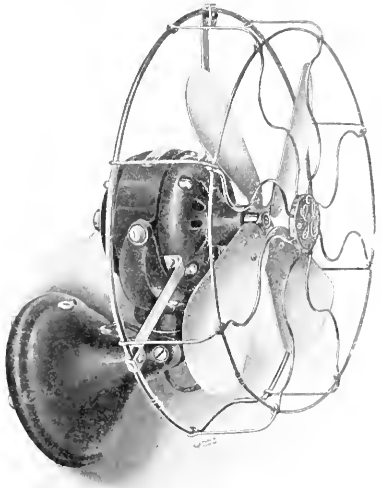
The General Electric Company's fan motor models for 1911 represent an exceptionally complete line designed for satisfying the requirements of a wide field of application. Several marked improvements are noticeable, one of particular importance being the adoption of a new induction winding for the 8, 12 and 16-inch alternating current fans, which obviates the use of a centrifugal switch for controlling the starting winding, thus eliminating all noisy contacts and insuring quiet operation with low energy consumption and great speed range.



G. E. Alternating Current Plain Type Ceiling Motor.

The entire line includes both a.c. and d.c. 8-inch four-blade desk, bracket, oscillating and telephone booth fans; 12-inch 6-blade residence, bracket and oscillating fans; 12 and 16-inch standard desk and bracket fans; 12 and 16-inch oscillating fans for either desk or bracket use; together with a great variety of ceiling counter column and floor column motors of attractive plain and ornamental design.

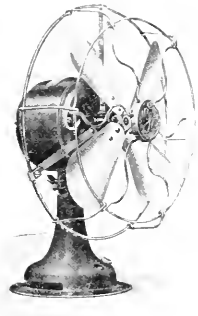
The desk, bracket and oscillating fans in general are readily convertible for either desk or bracket use and vice versa, by means of a hinged joint, attaching the motor body to the base, which permits of an extremely simple and quick vertical adjustment. The telephone booth fans are suspended from suitable brackets by means of a spring suspension, thus preventing any vibration from being transmitted



G. E. Alternating Current Bracket Fan Motor.

to the walls of the booth. The six-blade fans operate noiselessly and are designed especially for use in residences, hospitals and other places where quiet operation is desirable.

These motors are equipped with suitable switches for giving three speeds, the maximum ranging from 1250 to 1600 r.p.m., thus providing a regulation sufficient for all requirements. The a.c. motors carried in stock are for circuits of 25 cycles at 110 volts; 40 cycles at 120 volts; 50 cycles at 100,



G. E. Alternating Current Desk Fan Motor.

110, 220 and 220 volts; 60 cycles at 110 and 220 volts; and 133 cycles at 110 volts. The d.c. motors are for 110 and 220 volt circuits.

The a.c. ceiling and column fan motors are designed for operation on 25, 40, 50 and 60 cycle circuits. The plain types have two speeds, ranging from 150 to 225 r.p.m. The d.c. motors are designed for 110 or 220 volt circuits. The plain

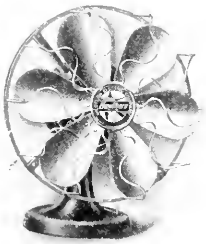
types operate at 200 r.p.m. The ornamental single speed types operate at 200 r.p.m., and the three speed types at 100, 150 and 200 r.p.m.

Both the a.c. and the d.c. fans are of the four-blade type, the former have a sweep 52 inches, and the latter 58 inches. They are of handsome design, workmanship and finish, and are wired for electrolier attachments of two or four lights.

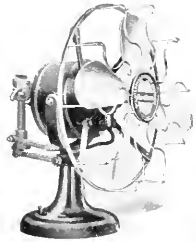
NEW "WESTERN ELECTRIC HAWTHORN" FAN MOTORS.

To the already large list of "Western Electric Hawthorn" electric fan motors five new types have been added, and the line is now sucn that it will meet every requirement necessary to good ventilation.

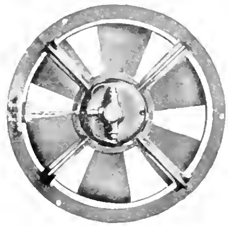
The most important addition to the line is a new mechanically operated oscillating fan. The oscillating device consists of a double worm reduction controlled by an oscillating lever. The gears are enclosed in a dust-proof case which



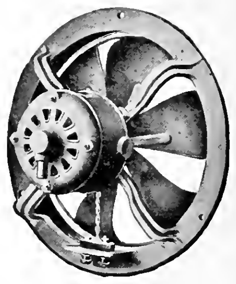
12 in. A. C. Residence Type Desk and Bracket Fan Motor.



12 in. Hawthorn A. C. Mechanically operated oscillating fan as desk type.



16 in. D. C. "Hawthorn" Ventilating Fan with Blackman Blades.



16 in. A. C. "Hawthorn" Ventilating Fan with Blackman Blades

is filled with lubricant. Tool steel is used for the worms and phosphor bronze for the worm wheels, thus insuring long life for the mechanism. In this fan the much desired trunnion feature is retained, thus making a wide adjustment in the

32 in. "Hawthorn" D. C. Ceiling Fan

vertical plane possible when the fan is used either as a desk or a bracket type. The oscillating motion is smooth and even, and wholly free from jarring. The range of oscillation is 90 degrees and is adjustable.

The success of the 12-inch, alternating current, six-blade residence fan introduced last year has led the company to place on the market this same style of fan for use on direct current circuits and also an oscillating fan of the six-blade type. As the increase in the number of blades allows the speed to be cut down without any decrease in the volume of air moved, this fan operates noiselessly, and because of this fact has become popular. It can be adapted for use either as a wall or bracket type and has two speeds.

Another type of direct current fan has been developed, known as the 32-inch ceiling fan. This fan is attractively designed and is well adapted for use in small offices, houses, hotels, clubs, etc.

In exhaust fans the popular "Hawthorn" fans are being furnished with the well known Blackman blade, a feature which will be appreciated by all users of small ventilating outfits.

The line of "Western Electric Hawthorn" fans now consists of 8-inch, 12-inch and 16-inch desk and bracket fans; 12 and 16-inch oscillating fans; 8-inch telephone booth fans; air operated and mechanically operated oscillating fans and a full line of battery fans, ceiling fans, column fans and exhaust fans for all commercial voltages. These fans are made in various sizes for use on all standard commercial circuits, both alternating current and direct current.

NEW CATALOGUES.

The Fort Wayne Electric Works is distributing a handsome book of souvenir views of Fort Wayne, "Indiana's busiest, happiest city."

The Southern Pacific Company has issued an excellent map of California, 20x24 in., together with a brief description of its resources, attractions, topography and climate. The map is in colors, different colors designating the characteristic climate of each section.

Westinghouse Electric Fan Motors for 1911 are fully illustrated and described in detail in Circular No. 1165 from the Westinghouse Electric & Manufacturing Co. Folders 4100 and 4101 give more condensed statements regarding alternating and direct current fans respectively.

The Pacific States Electric Co. of San Francisco, Oakland, Los Angeles and Portland, has issued a 936 page catalogue of electrical supplies and machinery, telephone and construction material. This volue is substantially bound and beautifully printed and is a veritable encyclopedia for the electrical purchaser. Apparatus listed includes sockets (57 varieties), receptacles, fuses, switches and switchboard equipment, insulators, line material and linemen's tools, conduit and fittings, electric heating appliances, fans, flashes, batteries, electric lamps and fixtures, motors, meters, telephones and telegraph equipment of all kinds, wire and cable, together with a wealth of wiring data. The catalogue as a whole is the largest and most complete ever issued by a Pacific Coast house. It is supplemented by a price list embodying several unique and valuable ideas to facilitate its use.

NEWS NOTES

FINANCIAL.

DORRIS, CAL.—The election held here on Tuesday resulted in favor of issuing bonds to the extent of $12,500 for the purpose of constructing a municipal waterworks system and supply.

LAS CRUCES, N. M.—The Board of Trustees of Las Cruces will call a bond election to vote on the question of issuing bonds for the construction of a municipal water-works and sewerage system for this city.

ILLUMINATION.

DAYTON, WASH.—The Dayton Electric Company has applied for a franchise for an electric lighting plant here.

THE DALLES, ORE.—The Aldermen are figuring on erecting an electric light plant. No definite plan has been suggested.

OREGON CITY, ORE.—The Mt. Hood Railway & Power Company has asked for a franchise to furnish this city with cluster lights. E. T. Bowness is the engineer.

PORTOLA, CAL.—An electric light plant will be installed soon. The company was incorporated six weeks ago with C. H. Gardner, president, and D. L. Tyre, vice-president and general manager.

SAN FRANCISCO, CAL.—It is announced by the City Electric Company that stockholders who desire to join a pool of not less than two-thirds of the entire stock may deposit their shares until August 1, for sale at not less than $80 per share.

IMPERIAL, CAL.—C. S. Chestnut of Redlands, representing Redlands and Los Angeles capitalists, has presented to the City Trustees a proposal to build and have in operation within five months, an electric light plant, if given a contract for lighting the streets at a rate not greater than the present rate.

TRANSMISSION.

BOISE, IDAHO.—The United States supervising engineer F. E. Weymouth, announces that the construction of a 15,000 h.p. water plant is contemplated in this vicinity.

PLACERVILLE, CAL.—For the purpose of generating electricity H. C. Witman has filed on 12,000 miners' inches of the water of the American River at different points.

LIBBY, MONT.—The Milwaukee Electric Power Company has filed articles through J. H. Ehlers and will develop power on the Yank River in the western part of Lincoln county.

SAN FRANCISCO, CAL.—The Great Western Power Company has practically closed negotiations for the purchase of the City Electric Company. The Great Western has been represented in its dealings here by H. P. Wilson.

LOS ANGELES, CAL.—Sealed proposals will be received at the office of the United States Reclamation Service, Federal Building, Los Angeles, Cal., until March 10, 1911, for furnishing turbine water wheels for the Salt River Project, Arizona. For particulars address United States Reclamation Service, Federal Building, Los Angeles, Cal., or Washington, D. C.

RED BLUFF, CAL.—Fred T. Horton has filed a water notice claiming 10,000 inches of the flowing water of Mill Creek, for the purpose of generating electricity, and producing power. Mr. Horton is a resident of Berkeley and a brother of Frank E. Horton, president of the Sierra Electric Power Company. It is supposed that this filing was in the interest of this corporation.

EXCHEQUER, CAL.—Sidney Sprout, formerly the consulting engineer for the Merced Falls Gas & Electric Company, has examined the power house and plant of the Exchequer Lighting & Power Company for the purpose of reporting upon a new site for the new power plant that is to take the place of the one destroyed by the recent flood in Merced River canyon.

REDMOND, ORE.—It is understood that the Crook County Water, Light & Power Company, owners of the power site at Cline Falls, on the Deschutes River, four miles west of this city, is having plans made for the development of power at that point, and as soon as the plans are fully worked out, machinery will be installed and a transmission line run from the falls to this city. The company contemplates putting in machinery of sufficient capacity to generate enough power to supply all this section of the county with lights and power, and run a transmission line to Prineville, 20 miles from here, to supply that city also with light and power.

TRANSPORTATION.

CENTRALIA, WASH.—The Twin City Light & Traction Company will extend its Centralia line to a connection with the new line of the Grays Harbor & Puget Sound Railroad on North Tower avenue.

BURBANK, CAL.—F. A. Halabug has been awarded the franchise for an electric line on Fourth street, Burbank, which was ordered for sale by the Board of Supervisors on petition of Burbank residents.

NORTH YAKIMA, WASH.—Farmers of Naches and vicinity are urging the extension of the electric road of the Yakima Valley Transportation Company from Fruitvale to a point three miles beyond Naches City.

PORTLAND, ORE.—Bids have been received for clearing the right of way for the Mt. Hood Railway & Power Company's transmission line across the Sandy River Valley, and it is expected that work will soon commence.

SOUTH BEND, WASH.—President J. O. Crary of the Twin City Electric Company has accepted the street railway franchise recently granted by the city of South Bend for an electric car line through the streets and alleys of the city.

SAN BERNARDINO, CAL.—The gap in the trolley route between San Bernardino and Upland will be shortly closed by the Southern Pacific Railroad Company, and a through line will be built from Santa Ana and Colton, thus completing a loop.

HOOD RIVER, ORE.—Pres. J. E. Eccles of the Mt. Hood Railway, a new road now running from Hood River to Parkdale, says it will be extended 5 miles as far as London Powers ranch. Mr. Eccles and W. H. Ingles, the promoters, live in Ogden, Utah.

FRESNO, CAL.—The Supervisors have adopted a resolution calling for bids for certain franchises along the proposed route of the Fresno, Hanford and Summit Lake Railroad between this city and Kingsburg and Centerville, applied for by the Fresno-Hanford road.

SACRAMENTO, CAL.—Senator Finn's bill, which gives to San Francisco the right to build a municipal street railway over East street from the Presidio to Hunter's point, has passed in the Assembly without a dissenting vote and is now

ready to be sent to the Governor. The bill was amended before final passage merely to provide against the possibility of the city of San Francisco ever transferring the grant.

SAN JOSE, CAL.—Improvements on the First street railroad system, which includes all the branch lines of the road which are now being made, will be finished, it was estimated, within thirty days at a total cost of $400,000. The San Jose Railroad Company controls the lines. The system is being broad-gauged over ten miles of trackage and the newly renovated broad-gauge cars are being put into use as fast as the various sections of the road are finished. The paving contracts alone on the work will aggregate $200,000. The broad-gauging of this road means the eventual improvement of the line between this city and Alum Rock. This line covers seven miles and is now operated as a single-track, narrow-gauge road. It will be double-tracked and broad-gauged as soon as the First street work has been completed.

VALLEJO, CAL.—The Vallejo and Northern Railway Company, associated with the Northern Electric Railway Company, has made the first step toward changing its proposed route southward from Sacramento to the bay. This follows the action taken by the board of directors of the company at a meeting held at Suisun last week when it was decided to abandon the fight for a franchise in Vallejo and adopt the other route in preference to that along the Mare Island channel, where the company has already sunk $50,000 buying a tideland right of way. It is stated that citizens of Benicia have assured the railway company of a private right of way and terminal facilities upon deep water, shortening the route to San Francisco by over an hour. It was the original intention of the company to create its terminal in this city, building by way of Cordelia, Napa Junction and Vallejo.

ALAMEDA, CAL.—The first shipment of cars for the new Alameda electric system of the Southern Pacific Company reached the Oakland mole from the East last week and will be transferred to the car shops at the mole, to be given the finishing touches before being ready for service on the system which is to start operation this summer. The cars are all-steel coaches, about seventy feet long and will seat 116 passengers each. The seats are of rattan, arranged crossways, with an aisle between and at one side of the center of the cars. On one side the seats are the regulation two-passenger rattan seats, while on the other side of the aisle the seats are longer, accommodating three passengers each. The cars, as they come from the factory, are equipped with big, open platforms, which the Southern Pacific Company will vestibule, allowing two entrances at each end of each car, which will facilitate discharging passengers and taking on new passengers. Other shipments are promised at regular intervals without further delay, and the cars will be all on hand by the time the road is ready to operate. About thirty cars will be needed for the Alameda service alone.

OAKLAND, CAL.—A block system which will absolutely prevent rear-end collisions on the Key Route system has been installed and the trains are now running by the semaphore signals of this system, though official orders have not yet been issued the trainmen. Rear-end collisions are the only kind possible under the double-track system of this line. The block system is so arranged that a passing train automatically sets the signals for the trains following. As the train passes, the signal is set for "danger," and when the semaphore is in this position a trigger extends in such a manner that should another train attempt to pass, an air valve on the roof of the first car of the train violating rules would be thrown open, the air brakes set and the train brought to an immediate stop. When a train has passed a signal several hundred feet, the signal automatically drops to "caution," which requires the motorman to so run a following train that he can bring it to a quick stop without damage. When a train has passed far enough to make the line regarded as clear, the signal is automatically thrown to "safe" or "clear." If the apparatus should get out of order, the result would be to throw every signal on the line affected to "danger," and bring all trains to a stop.

TELEPHONE AND TELEGRAPH.

GRIDLEY, CAL.—The Home Telephone Company has applied for a franchise in this city.

MODESTO, CAL.—A. V. Faight is organizing a new telephone line. His company will begin construction work at once.

TOPPENISH, WASH.—The Yakima Valley Telephone Company will soon begin the installation of telephones in local business houses.

CHICO, CAL.—John Leeper has announced that arrangements for putting the Home telephone system in Chico in competition with the Bell lines are complete.

VALE, ORE.—Harry Abram, representing the Vale Independent Telephone Company, has applied for a franchise for the establishment of a telephone system here.

SAN FRANCISCO, CAL.—Beginning March 1 the W. U. Telegraph Company will inaugurate a day letter service similar to the night letter service instituted a year ago.

MERCED, CAL.—The petition of E. B. Thomas for permission to erect poles and construct a telephone line in the town of Livingston and along the county roads has been granted.

SAN FRANCISCO, CAL.—The annual report of the Pacific Telephone & Telegraph Company for the year ended Dec. 31, 1910, shows that, including the amount charged to operating expenses, but transferred to replacement reserves, the earnings for the common stock were equal to 11 per cent, as compared with 12.8 per cent for the previous year. The relatively smaller amount of earnings for the stock in 1910 than in 1909 was due in part to the increased interest charges. At the end of the year the total amount of replacement reserves was $4,190,566, as compared with $2,334,336 for the previous year, and with $190,250 at the end of the year 1908. The full amount of these replacement reserves has been charged against earnings in the last three years. The total amount is equal to 23.28 per cent on the $18,000,000 common stock, or at the rate of nearly 8 per cent per annum. It is thus seen that when the directors of the company decide that their replacement reserves have been accumulated to near the proper figure it will be an easy matter to begin the payment of dividends on the common stock. During the last few years the company's capitalization has been increased considerably, due to large expenditures for the rebuilding of the plant. The gross earnings, however, have more than kept pace with the increase in capitalization. In 1906 the percentage of gross earnings to capitalization amounted to 16.01 per cent, while in 1910 the percentage amounted to 20.44 per cent. In 1906 the capitalization per station amounted to $184, while by the end of 1910 the capitalization per station had been cut down to $160, notwithstanding the heavy increase in the amount of outstanding stock, bonds and notes.

WATERWORKS.

MADRAS, ORE.—Construction work on the new waterworks system for Madras has commenced. The work is in charge of Engineer Gordon who estimates the cost at $11,000.

KINGSBURG, CAL.—Sealed bids will be received by the Board of Trustees of the city of Kingsburg, Cal., up to 1 p. m., March 15, 1911, for furnishing any part or all of the material and labor required to construct a municipal water-works system in this city.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVI | SAN FRANCISCO, MARCH 11, 1911 | NUMBER 10

ST. MARY'S HOSPITAL POWER PLANT

The field of operation for an isolated power plant included in the equipment of quasi-public buildings is nowhere better exemplified than for use in the modern hospital. Here electricity is put to scores of uses and the auxiliary features of the plant, i.e., the distribution and circulation of steam, hot and cold water, compressed air or vacuum, together make almost every condition of operation and action except, of course, the human element, dependent upon the power plant.

The equipment of St. Mary's hospital in San Francisco is perhaps as complete and thorough as modern science can dictate; the arrangement, unlike many isolated equipments having been consistently worked out to accomplish the best results in efficiency, ample space, light, air and general accessibility.

St. Mary's Hospital, front view showing Main Entrance

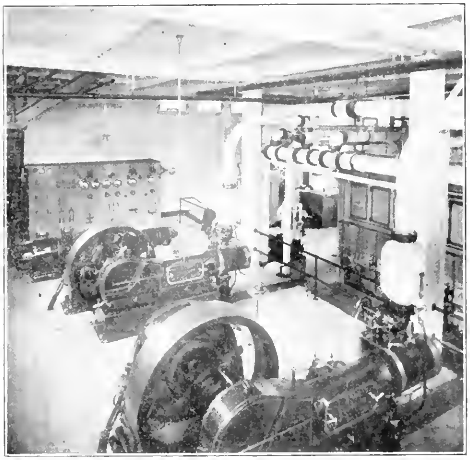
The hospital is as yet unfinished, in that several more wings are to be added as requirements may necessitate. The power plant is therefore designed for additional units to provide for increased service.

The building is a fireproof reinforced concrete structure of six stories, the finish being in a Spanish Renaissance type of architecture, the color scheme pure white. Placed within spacious grounds, the general effect is pleasing and gives to the institution an air of cheerfulness which is of particular value in a hospital.

That part of the structure containing the power plant, contains also the kitchens and accessory departments; it is two stories high and is detached from and in the rear of the main buildings.

The power plant occupies the ground floor which

is in reality a basement as it is a few feet below the ground surface. The engine and boiler rooms are one large room, about one-third of the space being occupied by the generating sets and switchboard, while



General View of Engine and Boiler Room.

the remainder contains the boilers and auxiliaries. The latter space is at a lower level by about three feet than the engine floor and an iron railing divides the spaces. Adjoining the engine and boiler room is a room devoted to various tanks, machine and carpenter shops, etc.

There are at present two main generating sets which are duplicates. The engines are Brownell high speed non-condensing, the bore and stroke being 13x14 in. They are fitted with Rites inertia governors and direct connected to General Electric six-pole, 75 kw., 250 volt direct current generators, operating at 275 r.p.m.

Set transversely between the nearest engine unit and the switchboard is a 30 kw. motor generator for supplying direct current when it is not desired to run the main generators. This set consists of a 250 volt direct current generator, coupled to a 50 h.p. two-phase induction motor operating from the regular service lines of the power company. It is possible, when desirable, to run this motor generator in parallel with the generating units.

There is in addition to the motor generator, a balancing set consisting of two 7 kw. direct current generators; this is for the purpose of balancing the load on the three-wire lighting system.

A second motor generator supplies direct current at 110 volts for the operation of signal bells and, together with a storage battery, is controlled through a panel board mounted directly over the set. This motor generator consists of two 1 kw. direct current machines, the one taking current at 220 volts and the other delivering at 110 volts.

A switchboard of six Vermont blue marble panels is placed at the end of the engine space and parallel to the engines. The first two panels control the main generators, and are equipped with the usual switch, circuit breaker and ammeter, there being one swinging voltmeter for both panels.

The third panel controls the balancer set; the fourth the motor generator set, there being switches, ammeters and circuit breakers for both the induction motor and the direct current generator. The fifth and sixth panels control respectively the power and lighting circuit. On the lighting panel, the main switch is double throw, enabling the use of direct current from the plant or the alternating current from the outside source. A trunk switch on panel three is provided to connect the power and lighting circuits, or by opening, to enable the power to be derived from one generator and the lighting from the other.

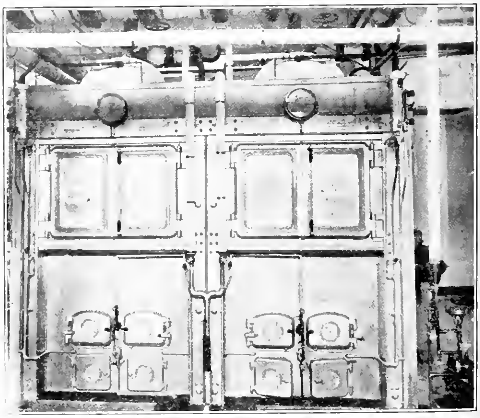
A master clock with circuit board, operated either by storage battery or from the 110 volt circuit, governs all clocks throughout the buildings.

There are two boilers which occupy the central part of the boiler space, leaving an opening on one side for the installation of additional boilers, while the space on the other side is taken up with the various auxiliaries. The boilers are Franklin water tube, and are rated at 132 h.p. each. The heating surface of each is 1328 square feet. The pressure maintained on the boilers is 125 lb.

The furnaces are equipped with Wilgus oil-burners.

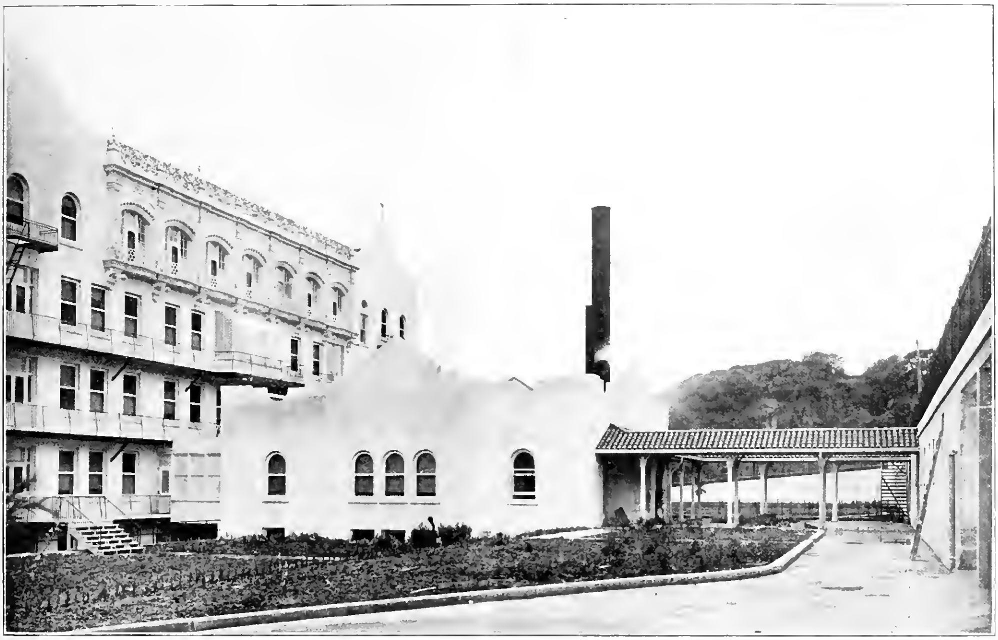
Exhaust steam from the engines is delivered directly into the house heating system, which provides for both direct and indirect radiation. The system operates at a pressure of from 1½ to 2 lb; steam returned on a wet vacuum system is delivered to a Cochrane feed-water heater. This is placed next to the low wall which divides the engine from the boiler compartment and directly adjoining it are two Fairbanks-Morse boiler feed-pumps. Still beyond these are the two fuel oil pumps.

In the space reserved for auxiliaries next the boilers are placed two house steam-pumps, which deliver water for all purposes throughout the buildings on the



Battery of Two Franklin Boilers.

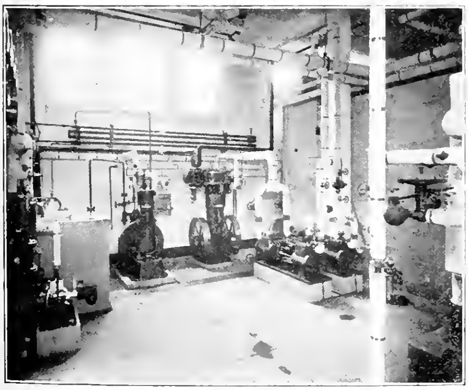
Kewanee system. This water is drawn from a well and piped nearly one mile to a 20,000 gallon tank, placed under the sidewalk adjoining the building. From this tank it is pumped as needed.



Power Plant and Kitchen Wing.

There is next a "six-house" vacuum apparatus. This machine, which is in reality a steam operated air pump, supplies the vacuum necessary in sweeping and cleaning.

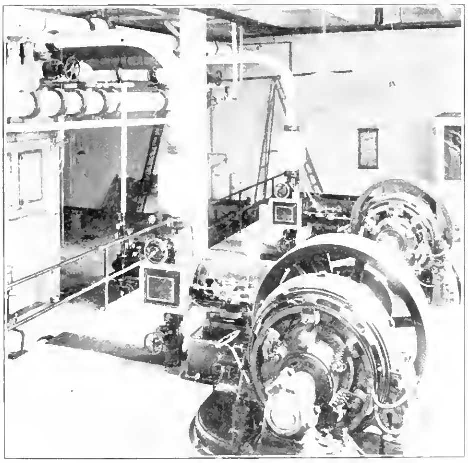
The remaining apparatus is a Vulcan Iron Works refrigerating machine which is capable of supplying 600 lb. ice per day; and a steam driven brine pump, which circulates brine for refrigerating purposes in the kitchens, cold-storage rooms and therapeutic room.



Auxiliary Plant adjoining Boilers.

Placed on the wall in plain view from all parts of the plant is a Vermont blue marble gauge board. This is 3x6 ft. and contains six gauges, as follows: 1, Sterilizing steam; 2, vacuum on heating system; 3, high pressure steam; 4, city water pressure; 5, kitchen steam pressure; 6, heating steam. Passing from the engine and boiler room to the adjoining room, there is a small machine shop, and also a carpenter shop equipped with motor operated tools.

In this room are also placed a Jewell water filter, receivingtanks for the vacuum cleaning system, a



View of Generating Units from the Switchboard

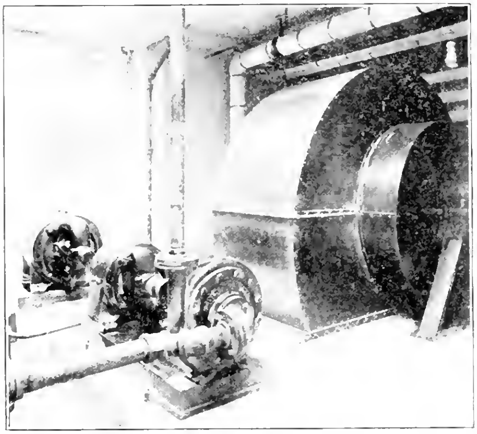
Wainwright water heater for faucets and general house use and the main and surge tank used in the water supply of the building.

One passenger and two service Otis elevators are operated by electric motors, the passenger and one

of the service elevators having magnet control, while the third, which is an ambulance elevator, has a floor selector push button control.

In an extensive marble-lined bath department, steam, hot and cold water, electricity for "electric-light" baths and for vibratory massage is supplied.

Steam is supplied to a machine which fumigates mattresses as well as to an extensive laundry and for use in cooking in the kitchens. There is also a debris incinerator.



Motor-driven Pump for Air washer and Centrifugal Suction Blower, Delivering Sterilized Air.

All odor of cooking and excess heat are taken from the kitchens by an exhaust fan driven by a 2 h.p. General Electric motor, and a 3 h.p. motor of the same make drive an ice-cream freezer and a sausage machine.

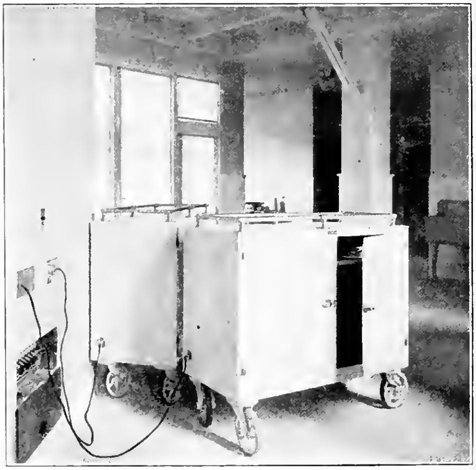
In a hospital the necessity of fresh air at a proper temperature, which may be regulated at will, is one of the greatest importance. Outside air is drawn through a Webster air washer by an exhaust fan. This fan placed in a closed room, tends to exhaust the surrounding air, the only ingress being through the washer. In passing through the latter the air comes in contact with a spray of water which carries away all particles of dust and gives the required humidity. A United Iron Works centrifugal pump driven by a 1 h.p. General Electric motor furnishes the water spray. The exhaust fan is driven by a $7\frac{1}{2}$ h.p. motor and operates according to requirement from 450 to 900 r.p.m.

After passing through the fan, the air is driven through a heater. This is supplied with three sets of steam heating coils which allow a variation in the temperature of the air which is then delivered to all parts of the building.

A system for drawing impure air from all parts of the building is operated by an exhaust fan placed in a room on the roof. This fan and the driving motor is similar to the set just described.

Throughout the building is a comprehensive system of signal lights and calls from all rooms and here a novelty has been introduced. Instead of the familiar electric bells or buzzers, which are often annoying to nervous patients, there is, on each floor, a Westminster chime of four tones. These chimes consist of bell-metal tubes which are sounded by an electrically operated hammer. The different pitches of tone denote nurses or attendants of different grades of authority, while the number of strokes signify the individual wanted.

Another novelty is an arrangement for electrically heating the tray carriers. These carriers are of sheet metal in the form of a large box in which are fitted shelves, the whole being mounted on rubber tired wheels. Within is a heating coil which enables food in trays to be kept warm while the carrier is being filled and during its journey to the various wards. At a convenient place near the kitchen, there are several wall plug receptacles supplying the current to heat the tray carriers and a set of baby knife switches provided directly under them control the current. This novel heating system was invented by Mr. J. Hughes, the chief engineer of the hospital and the tray carriers were supplied by the Butte Electric Company.



Tray Carriers and Method of Connection for Electrical Heating.

This plant is undoubtedly a model of its kind and much credit is due to the Compressed Air Machinery Company for its design and installation.

ELECTRIC AIDS FOR PHOTOGRAPHY.

Anyone who is working with the old-fashioned appliances still in use in many photographic darkrooms would be astonished and delighted with the results which can be secured by the use of various electrical devices recently described in the Edison Monthly. By means of these not only can the tedious process be hastened, but it is possible to obtain finer effects in developing and printing.

A lighting innovation, the powerful aristo, is used in making enlargements. It is in an asbestos case, so that the light falls only on the photographic plate placed in the enlarging frame. By moving a lever the intensity can be changed from a comparatively low power to forty times daylight intensity. The illumination produced is stronger, steadier and gives

less heat than is possible with any other kind of light. Anyone who has done enlarging will realize the time saved in this way. In making line reproductions, in other words, those where the color is not being copied, a mercury vapor lamp gives especially satisfactory results. This light has the peculiar effect of hardening all lines; a seemingly blacker black stands out vividly from a clear white, very effective in copying line drawings. More novel than the lighting arrangement are the various electric heating apparatus that the photographic department of The New York Edison Company has adapted for its work. There is the electric fan to expedite drying, and for extra quick work, a dryer, usually seen in hair-dressing parlors, has been found extremely serviceable. Several plates on a rack can be dried at once by use of the fan, the process taking from one-half to two hours, depending on the humidity of the air on any particular day. The current of warm air from the hair dryer can be directed only on one negative at a time, but the work is done in fifteen minutes. When one considers that without these extraneous aids it frequently takes twelve hours for plates to be ready for printing, the usefulness of these electric appliances can easily be seen.

Another advantage is that it is possible to do finer work in this way. Printing from a wet plate, or from an enlargement, are old tricks where newspaper photography is concerned, but such treatment, while giving the desired speed, will never give fine results. The effect, though, of the warm air from the electric dryer on the plate aids in bringing out the details which might otherwise be lost. Even the directions to amateur photographers suggest that the films are better if dried in a warm room.

In mounting, an electric flatiron gives excellent results. This is done by use of gum tissue, which is placed between the print and the cardboard. The electric iron is then applied and a perfect piece of mounting results, since the print has absolutely no chance to curl, while crooked placing can be remedied by the application of a little more heat. Large photographic houses recommend a regular heating press, which costs at least $50 to buy, and a considerable sum to maintain. Such an equipment, however, is desirable only when an immense amount of work must be turned out, but for the ordinary shop, where two hundred prints must be mounted in a day, the electric flatiron, costing one-tenth as much, will perform the same service.

An electric radiator facilitates operations in the dark room. Hitherto many photographers have been forced to do this portion of their work in a cold room, since steam heat is too damp, and gas heating gives out too much light at the same time. An electric radiator gives dry heat with no lighting effect, and while the room is warming, water for warm solutions can be set upon the radiator. Any persons interested in seeing these improvements may secure permission to visit the photographic department of this company and see the apparatus in use and notice the results obtained.

Amateurs who are acutely aware of the length of time ordinarily consumed in the drying of negatives and prints may be interested to know how newspapers publish in their afternoon editions pictures of some event which occurred not more than three hours before. In order to do this newspaper photographic departments do not wait for their negatives to dry at all, but "print from a wet plate," as it is called.

To do this, the negative, as soon as it has been developed, is placed still wet in the enlarging frame. It does not come in contact with any printing paper, so the soft surface is not damaged. In the enlarging process, a strong light is thrown through the plate in the frame, the enlarged positive reflection being thrown on a screen some feet off. The printing paper is then put upon the screen and the photograph printed directly upon it.

While this method has the advantage of extreme speed, it cannot produce fine work, for when the plate, still wet, is put in the frame the gelatine has not yet "set," as it were, so that lines and shadings have not become clearly defined. Then when this is enlarged the muddiness of outline is increased.

This system of printing from a wet plate, combined with the quick printing, goes to account for the poor quality of so many of the pictures which appear in daily papers. This difference becomes strongly marked where some publication has a carefully prepared weekly supplement in which the photographs are extremely good, while many of the pictures seen in the daily editions are inferior. Newspapers that care about the appearance of their daily editions could adopt these various electric devices to use where the speed, though not the greatest, is required.

ELECTROLYTIC IRON[1].

BY CHARLES F. BURGESS

During the past five years investigations have been carried on in the chemical engineering laboratories of the University of Wisconsin, dealing with electrolytic refining of iron and its use in the production of alloys. About 3 tons of iron have been refined and over 1000 alloys produced and tested. While this experimental work has been on the "test tube" or laboratory scale, it is believed that some of the results indicate the feasibility of enlargement to commercial state, and a short discussion is submitted here bearing on the question, "Can electrolytic iron be made an industrial product?"

Many old textbooks on electro-chemistry give descriptions of methods of depositing iron electrolytically, implying, therefore, that electrolytic iron is not a new product. The only use suggested, however, is for facing engraved plates used for printing. By following any of these earlier processes it is seen that only very thin layers of iron can be deposited, the coating tending to become dark, rough and powdery. It is to overcome this limitation that the work at the University of Wisconsin was undertaken, and that this has been successful, in a measure, is indicated by an iron cathode nearly 2 in. in thickness.

The manner in which electrolytic refining has revolutionized the copper industry is now an old story, and electrolysis has likewise become an industrial agent in the metallurgy of silver, gold and lead. Now

[1] Paper read before the Chicago Section of the American Electrochemical Society, Jan. 20, 1911.

that it has been found that iron can be refined electrolytically almost as easily as copper, it is pertinent to inquire whether there is a field of usefulness for such iron. This depends upon whether electrolytic iron has superior qualities due to purity or physical condition, and whether it can be procured at low cost.

From the standpoint of purity it must compete with some notable metallurgical developments which have resulted in product such as being made by the American Rolling Mill Company in a basic open hearth process. For this material a purity of 99.94 per cent is claimed and justifiably so, as some of our analyses show. The electric furnace is another factor which is contributing largely to the control of the composition and purity of iron alloys, and the striking possibilities which are offered in this developing field cannot be overlooked in advocating the development of an electrolytic iron process.

The chief source of commercially pure iron has been and, perhaps, now is, the high grade Swedish and Norway iron, used largely as a base material for high grade crucible steel. The analyses of this material usually indicate a high purity, though frequently and erroneously calculated by difference, after determining carbon, sulphur, silicon, phosphorus and manganese. It is not uncommon to find oxides and slag to the extent of 2 per cent in this material, and this impurity undoubtedly may have an influence on the resulting alloys made from it.

We have found that electrolytic iron can be produced with a purity as high as 99.97 per cent, and, perhaps, even better, using extraordinary precautions. This record has been made by using the best commercial grades of pure iron as anodes. A few hundredths of 1 per cent of purity must be sacrificed in using anodes of mild steel or other less pure materials. Electrolytic refining offers a means of reducing or screening out most of the impurities commonly found in iron and of producing a material not only of high purity, but of great uniformity. Even though it may be shown eventually that electrolytic iron may not have a higher purity than that attainable by other methods, the uniformity of its composition should make it a valuable material as a means of eliminating many of the variables with which the crucible steel maker has to contend.

Using an electrolyte containing 40 g. of iron per liter in the form of ferrous sulphate, together with 40 g. of ammonium chloride, it has been found possible to conduct a continuous refining operation for many months at a current density of 6 to 10 amperes per square foot of cathode surface, and at a potential difference of about 1 volt. The current efficiency is very close to 100 per cent, as it is in copper refining.

This leads to the calculation that 1 kw.-h. will refine 2 lb. of iron; or a cost for power of ½ cent per pound is attainable. The costs for labor, solution maintenance and fixed charges are estimated to be not greater than the power costs, making a cost of refining of about $20 per ton. Assuming the anode material to be a mild steel costing $35 per ton, the cost of electrolytic iron would be in the neighborhood of $55. These approximate calculations indicate that this material might well compete in price with high grade Swedish iron.

Among the properties of electrolytic iron which may give it some added usefulness is its content of hydrogen and the brittleness which results from this occluded gas. This hydrogen may be of some service in reducing oxides in a melt. The brittleness of the electrolytic iron before the hydrogen is driven off makes it easy to break it up into pieces suitable for introduction into the steel crucibles.

COPPER MARKET SITUATION.

There has been considerable activity in copper during the last few weeks, says Copper Gossip, but price changes in local circles cover a comparatively small range. February sales of moderate volume indicate a conservative inquiry from domestic melters, but the increase in actual buying is not great enough to bring about an advancing scale of prices above 12½ for electrolytic. At the same time the rate of home consumption is quite good considering the season of the year, but it will take more urgent demand on the part of manufacturers to create a pronounced effect upon the market.

With the approach of spring active inquiries for larger tonnages are expected. An increase in new business and better specifications for both raw and semi-manufactured products should stimulate trade the next three months. The danger is that when improvement gets well started some sellers may be inclined to rush the advance and check business in that way before the danger boundary is past. It is very probable that copper will emerge from the difficulties which have beset it sooner than some pessimistic persons anticipate, but it goes without saying that a moderate recovery based on genuine improvement will be safer and more satisfactory than the attempt to force matters artificially.

During the last two years the production of marketable copper by the refineries of the United States amounted to 2,857,525,176 pounds, a quantity more than double the world's output in 1903 and 1904. The figures of refinery production in this country for 1910 were more than ten times larger than domestic output 26 years ago. The rapid growth of the copper industry in recent years marks a period of phenomenal development at the leading mining districts. The great increase of output from the porphyry properties has given the copper market a big set back. These bodies of disseminated ores are worked by steam shovels, and the comparative ease with which they are handled tends to unusually cheap operating cost. The old fissure mines are more costly to work than the low grade propositions where conditions are exceedingly favorable for cheap mining.

The drastic decline in the market price of copper from the high figures of 1906 and 1907 has brought the selling price at present down to a strictly reasonable basis. At current values copper is certain to be in heavy demand by the manufacturers of the world. If the market were kept more liquid that fact in itself would tend to maintain consistent activity much better than by forcing buyers to pay a pegged price. The habit of fixing an arbitrary price gives no index of actual conditions, but by this mistaken method trading is made obligatory at the sacrifice of intelligent judgment and by ignoring natural laws.

MOTORS IN TELEPHONE EXCHANGES.[1]

BY C. W. BURKETT.

In the more modern common battery telephone exchanges of the Bell system, both direct and alternating current motors are used very generally. The spefic uses for motors in such telephone exchanges are as follows:

1. Alternating current motors of both single phase and poly-phase types and constant potential direct current motors are used for driving generators for charging storage batteries, which in turn supply the talking current and current for signalling purposes. These motors will vary in size from about 1½ to 48 horsepower and if direct connected to the generator will vary in speed from approximately 50 to 2000 revolutions per minute.

In that it is absolutely essential in a telephone exchange to have a reliable source of power, frequently two motor generator sets are provided for charging the main battery; one of these usually being direct current and the other alternating current, if these two sources of power are independent and available. If this is not the case, and if gas is available, one of the generators is usually driven by a gas engine.

2. A small motor in the larger common battery exchanges is usually provided for charging a smaller storage battery which is placed in series with the main storage battery to provide 48 volt current for use on long distance connections. This motor is usually of a capacity from 1 to 5 horsepower.

3. Usually two sets of motors, one either alternating or direct current, supplied from the city power circuit, and the other supplied from the storage battery, are provided for operating the service motor-generators which provide 30 volt direct current for operating service meters, used in connection with the recording of telephone calls. These motors vary in size form 1 to 2 horsepower.

4. In the larger exchanges, motors are provided for driving twin generators which supply 110 volt current, both positive and negative, for the operation of coin collectors, or what are usually termed "pay-back nickel machines." These motors will vary in size from ½ to 2 horsepower.

5. Both alternating and direct current motors from independent sources, are provided for operating ringing generators which are used to supply the current for ringing subscribers' stations and ringing on toll and "ring-down" trunk lines. These motors will vary in size from about ½ to 1 horsepower.

6. In all of the larger exchanges, motors are provided for driving generators for supplying 65 and 110 volt current for the operation of telegraph instruments used in conjunction with long distance telephone lines.

7. In many of the modern exchanges a ringing dynamotor is provided instead of a ringing generator in connection with a motor. This machine consists of a double wound armature and a single field, and is practically a rotary converter. Direct current for the operation of the machine is usually obtained from the main storage battery and the alternating current side supplies single-phase alternating current at approximately 75 volts and 16 cycles. These machines are usually two pole and are operated at 1000 revolutions per minute. They will vary in size from approximately 1/6 to 1 horsepower.

8. In the larger multi-office exchanges and particularly where considerable long distance or toll business is transacted, motors are provided for the operation of either a belt conveyor or pneumatic ticket distributing system. This system is used for the distribution of tickets from the recording to the toll line operators. These motors will vary in size from 1 to approximately 20 horsepower. The largest installation of this sort on the Pacific Coast is in the Kearny office of our San Francisco exchange. In this exchange we have a vacuum conveyor system which requires approximately 20 horsepower for its operation. Two motors are provided; one alternating and the other direct current. Either one or the other of these motors is in continual service and the other is used for reserve.

In the design of telephone power plants, it is usually found expedient to install motors which are somewhat in excess of the initial requirements. This is done in order that the entire central office equipment may be as nearly in cost equilibrium as possible. For this reason, motors for telephone use are required to conform to quite rigid specifications. Particularly is it necessary that the efficiency curves from approximately ½ to full load be flat as possible. It is also necessary in telephone motors that the speed limits be kept close, as the adjustment of telephone signalling apparatus, in common battery exchanges, is close and also, a difference in transmission will result if any considerable variation in voltage of the current supply be permitted.

We have in use a number of Western Electric direct current motors, Western Electric alternating current motors, Westinghouse and General Electric alternating current motors, both single-phase and poly-phase, Emerson single-phase motors for driving the smaller apparatus, as ringing machines and coin collecting machines, and Wagner single-phase motors usually used for driving the charging generators.

For a common battery telephone exchange of 10,000 subscribers, motors aggregating 100 horsepower for both operation and reserve will be required, while an exchange of 1000 subscribers require motors less than 10 horsepower.

Direct Current Motors.

The requirements for direct current motors upon which we have usually insisted are as follows:

Efficiency: The minimum efficiency for varying sizes is shown on the attached curve.

Type: The type of motor is, in every case, constant potential.

Heating: The heating requirements are as follows:

The motor should be capable of delivering continuously its rated output at the specified voltage without a rise above a room temperature of twenty-five degrees Centigrade.

Field and armature, by resistance measurement, fifty degrees Centigrade and by thermometer, forty-five degrees Centigrade.

Commutator and brushes, by thermometer fifty-five degrees Centigrade.

[1] Paper presented before San Francisco Section A. I. E. E., Feb. 24, 1911.

Bearings and other parts of the machine, by thermometer forty degrees Centigrade.

Further, the motor should be capable of running for two hours at a twenty-five per cent overload without injury to any of the parts.

Brushes: The motor should be provided with brush holders and carbon brushes of a type which will ensure satisfactory operation. The current density in carbon brushes should not exceed 35 amperes per square inch. For motors operating at less than 30 volts, metallic gauze may be used.

Commutation: The motor should run without injurious sparking from no load to 25 per cent overload without alteration of the position of the brushes.

Bearings: The motor should be provided with self-oiling and self-aligning bearings.

Speed: The speed should not vary more than 5 per cent between no load and full load, when the voltage of the supply mains is kept constant at the normal voltage. Variation of speed, due to a variation of 5 per cent above or below the normal voltage, should not exceed 5 per cent above or below normal.

When motors are used in combination with ringing generators, the motor should be capable of driving the generator under all specified conditions of speed and load.

Mounting: Depending upon whether the motor is direct connected to the generator or belt connected. It should, in the first case, be mounted on a rigid sub-base of cast iron or I beam construction, which sub-base should be common to the motor and the generator to which the motor is connected; or in the second case, the pulley should, of course, be of proper dimensions and width of face for belt driving.

Starting Box: In general the motor should be provided with a fireproof starting box and this box should be equipped with both an over-load and no voltage release. The starting box is usually mounted at the rear of the power switchboard.

Insulation: The insulation between the armature and field windings and between these windings and the frame, and, if direct connected, between the two machines and between the motor and the sub-base should not break down when subjected to the following mean effective differences of potential of alternating electro-motive force continuously applied for one minute.

Rated Terminal Voltage	Capacity of Motor	Testing Voltage
Not over 400 volts	Under 10 kilowatts	1000 volts
Not over 400 volts	10 kw. and over	1500 volts
400 to 800 volts	Under 10 kw.	1500 volts
400 to 800 volts	10 kw. and over	2000 volts

Alternating Current Motors.

Type: The motor should be of the self-starting induction type and should operate satisfactorily on an alternating current circuit of the voltage, frequency and number of phases specified.

Heating: The motor should be capable of delivering continuously its rated output at the specified voltage and frequency without exceeding the following rise above a room temperature of twenty-five degrees Centigrade.

Electric circuits, by resistance fifty degrees Centigrade.

Bearings and other parts of the machines, by thermometer, forty degrees Centigrade.

In squirrel cage or short circuited armatures, fifty-five degrees Centigrade, by thermometer, may be allowed.

Starting Torque: The motor should develop sufficient torque to start the machine to which it is connected, the machine being at no load.

Insulation: The insulation between the different circuits and between the primary circuits and the frame, and, if the motor is direct connected, between the two machines and between the motor and the sub-base, should not break down when subjected to the following mean effective differences of potential of alternating electro-motive force continuously applied for one minute:

Rated Terminal Voltage	Capacity of Motor	Testing Voltage
Not over 400 volts	Under 10 kilowatts	1000 volts
Not over 400 volts	10 kw. and over	1500 volts
400 to 800 volts	Under 10 kw.	1500 volts
400 to 800 volts	10 kw. and over	2000 volts

Speed: The variation of speed of the motor between no load and full load should not be more than five per cent when the voltage of the supply mains is kept constant and the frequency is normal. The variation of speed, due to a variation of five per cent in either voltage or frequency of the supply mains, should not exceed five per cent from normal.

Bearings: The motor should be provided with self-oiling and self-aligning bearings.

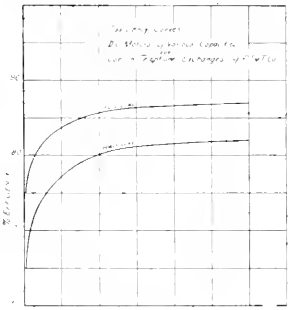


Fig. 1.

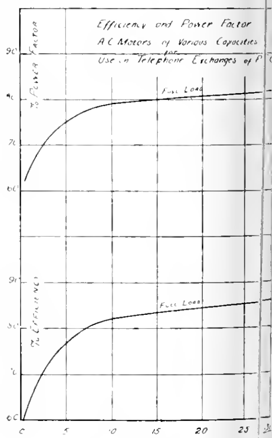


Fig. 2.

Mounting and Means of Driving: Depending upon whether the motor is direct connected to the generator or belt connected. It should, in the first case, be mounted on a rigid sub-base of cast iron or I beam construction, which sub-base should be common to the motor and the generator to which the motor is connected; or in the second case, the pulley should, of course, be of proper dimensions and width of face for belt driving.

Power Factor and Efficiency: The power factor and efficiency of alternating current motors at full load should not be less than is shown in the accompanying curves.

PHOTOMETRY OF SEATTLE STREET ILLUMINATION.

BY RAYMOND A. HOPKINS AND EARL J. BEERY.

With the recent rapid development of Seattle's street lighting good opportunity has been afforded for making experimental tests on several different lighting systems. The City of Seattle has taken steps far in advance of other western cities and is fast obtaining a degree of illumination for her streets which will rival anything in the East. The tungsten incandescent lamp has become the basis of all the new lighting. Lamps have been obtained in sizes ranging from 40 c.p. to 300 c.p., from which variety the intensity best adapted to the requirements of each individual installation is selected with precision.

One of the most satisfactory types of lighting and one quite extensively installed is that of the cluster lights. At the present time 1021 poles are lighted and 598 are under construction. The poles are of simple, neat design, unostentatious by day, and, owing to the unique arrangement of the globes in the form of a vertical triangle, plane perpendicular to curb, give a pleasing appearance at night. Three types of poles are used —a five-ball for business streets, a three-ball for residence districts and a single-ball for parks and drives.

To give some of the results obtained from tests made with a portable photometer on these five-ball clusters using both tungsten and gem lamps and also on some of the older systems of lighting, is the purpose of this paper.

The tests were made with a Sharp-Millar portable photometer. The instrument consists essentially of a milk glass, a movable tungsten battery lamp and a Lummer-Brodhun prism element with telescopic eyepiece. The milk glass can be rotated at the end of an elbow tube in order to receive illumination from any direction. The standard battery lamp is calibrated for voltage, the correct value being obtained by varying a resistance in its circuit and indicated by a voltmeter across its terminals.

For this series of tests the instrument was carried on a tripod, bringing the milk glass about four feet, four inches above the pavement. This height of the plane of illumination is about the height at which light is generally desired for seeing pedestrians, vehicles, etc., and is appropriate for these particular tests, since, as shall appear later, readings were taken in horizontal directions as well as vertical.

Four types of lighting were tested, one block of each as follows:

1. Tungsten cluster lights.
2. Gem cluster lights.
3. Enclosed arc lights.
4. Series tungsten lights.

The blocks of tungsten clusters and gem clusters selected for the tests are similar in all matters of importance and were chosen so in order to better show a comparison of the two lamps used in similar installations. The streets are red brick paved, the sidewalks gray cement, the buildings on both sides continuous and at least four stories high. Each block has four cluster poles on each side of the street set opposite each other. The poles are of the five-ball type and are provided with sand blast globes. The tungsten equipment consists of one 100-watt and four 60-watt, 115-volt, Mazda lamps, the gem of five 100-watt, 115-volt, gem lamps. Illumination readings were taken at twenty-five foot stations on lines parallel to the curb.

The blocks of enclosed arcs and series tungstens selected for testing are in residence districts. The streets are paved with black asphalt, the sidewalks are of cement. The arc equipment consists of 475-watt, 6.6-ampere arc lamps hung two to a block near the center of the street and about twenty feet above the pavement. The series tungsten lights consist of 52-watt, 6.6-ampere lamps supported two to a block from goose neck brackets, nearly over the curb, on one side of the street only, and about seventeen feet above the pavement. Illumination readings were taken at fifty foot stations on lines parallel to the curb.

During these experiments precautions were taken to secure the same conditions for the test of each type of lighting. The months of February and March were chosen and the hours of one to six a. m. Each night of the test the pavement was dry and the sky cloudy. All lights on the street other than those under test were turned off.

At each station five readings were taken as follows, each reading being checked by a duplicate, and, in the case of the arc lights, by a triplicate:

A. With the milk glass in a vertical plane and facing forward, that is, in the direction in which the stations progressed down the street.

B. With the milk glass in a vertical plane and facing toward the right.

C. With the milk glass in a vertical plane and facing backward.

D. With the milk glass in a vertical plane and facing toward the left.

E. With the milk glass in a horizontal plane and facing upward.

Thus, four readings were taken in vertical planes ninety degrees apart and a fifth in a horizontal plane

From these five readings three values of illumination have been derived:

1. Vertical illumination.
2. Mean horizontal illumination.
3. Total illumination.

The relation between and the derivation of these three values is at once clearly suggested by a brief reference to the point by point method of figuring illumination. When the candle-power of a lamp in a certain direction is divided by the square of the distance to a certain point in that direction the result is the total illumination received at the point from the lamp. This value multiplied by the cosine of the angle of incidence with any plane gives the value of the illumination in a direction perpendicular to the plane. Thus, if the plane is horizontal the vertical value is obtained; if vertical, the horizontal. If several lights are considered the value of the combined illumination is equal to the sum of the values obtained from the individual lights.

Returning to the experimental determination of these values, the vertical illumination shown on curve

[1] Paper presented before Seattle Section American Institute of Electrical Engineers, Nov. 19, 1910.

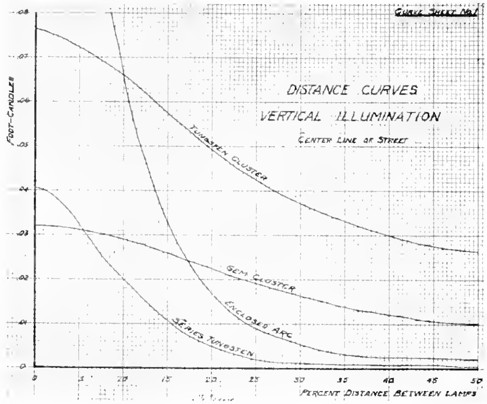


Fig. 1.

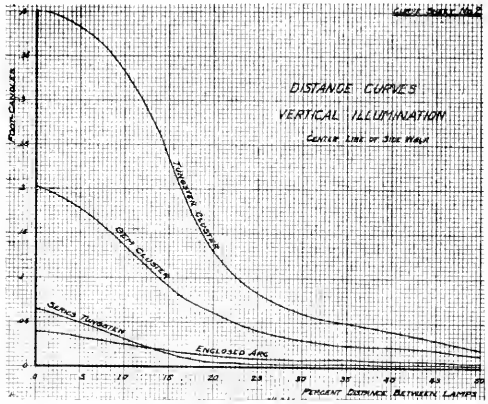


Fig. 2.

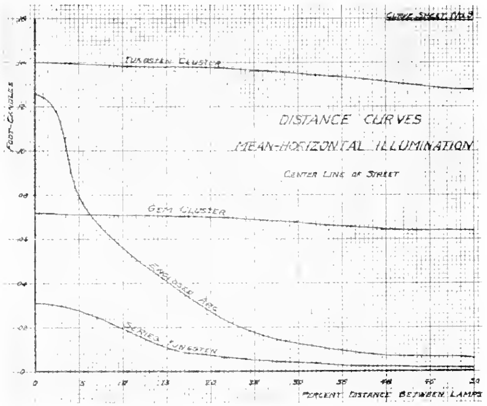


Fig. 3.

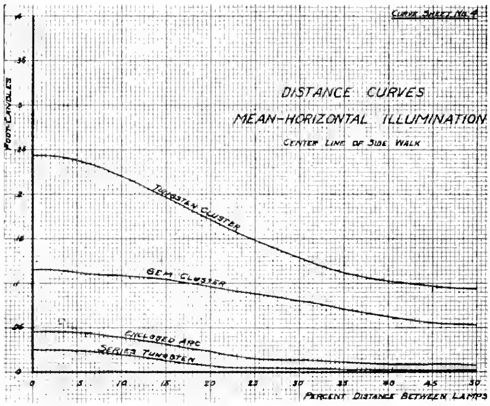


Fig. 4.

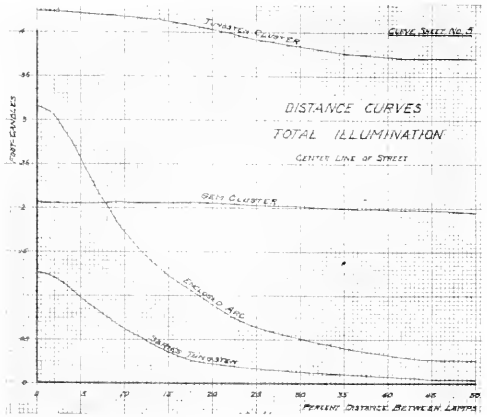


Fig. 5.

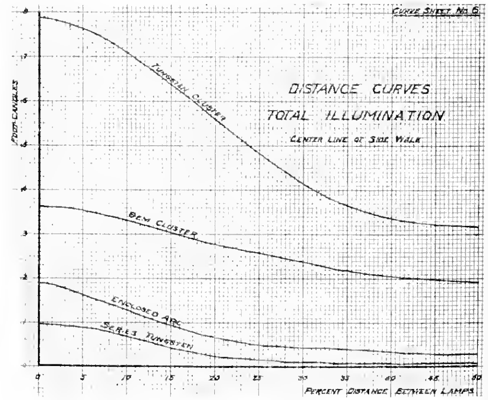


Fig. 6.

sheets Nos. 1, 2 and 7 is the E reading, above referred to, just as taken on the street.

The mean horizontal illumination shown on curve sheets Nos. 3, 4 and 8 is the mean of the A, B, C and D readings.

The total illumination shown on curve sheets Nos. 5, 6 and 9 is a deduction from the five readings using the equation.

Total illumination $= \sqrt{(A + C)^2 + (B + D)^2 + E^2}$

As is readily seen from the equation, the readings in

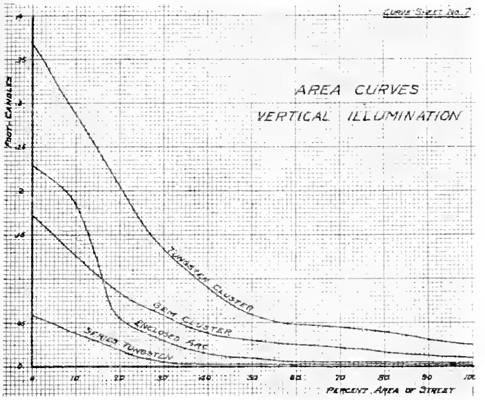


Fig. 7.

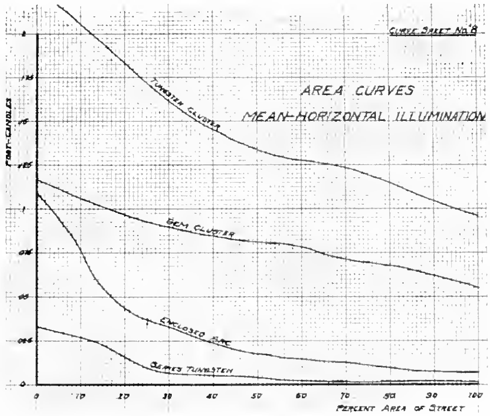


Fig. 8.

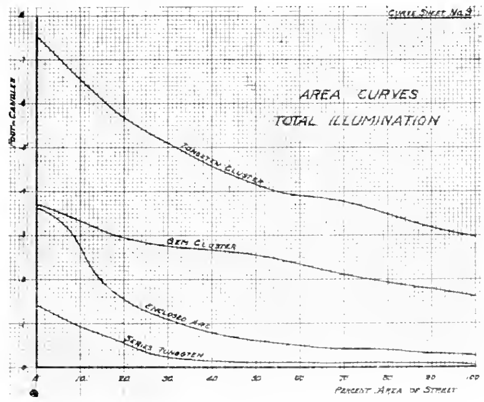


Fig. 9.

opposite directions have been added and their sums combined to form the diagonal of a cube, so to speak. Since no downward reading was taken the deduction which must necessarily result from reflection; but neglects the very small upward components of light these may well be neglected since they are not only of no value for illumination but are a positive hindrance.

This same value of total illumination is often obtained by one reading with a photometer equipped with a receiving device in the form of a sphere which receives light from all directions at once.

The results of the tests are shown graphically by means of two sets of curves, which from the nature of their abscissae, we refer to as:

1. Distance curves.
2. Area curves.

The ordinates are in both cases value of illumination in foot-candles.

The distance curves have for their abscissae per cent distance between lights along the line of set-ups mentioned above. Thus, referring to curve sheet No. 1, the vertical illumination, given by the tungsten clusters is 0.0425 foot-candles; gem cluster, 0.019; enclosed arc, 0.009; series tungsten, 0.002. This is, of course, at a point on the center line of the street in each case. At the point opposite this on the center line of the sidewalk, (curve sheet No. 2) we find the tungsten cluster 0.0825 foot-candles; gem cluster 0.041; etc. The per cent distance is used in place of the actual distance in feet in order that the four types of lighting, each having different lamp spacing, might be represented on the same sheet. It is to be noted that since the whole block was tested and all the readings plotted the irregularities that might occur throughout the block, from unequal reflection or other sources, do not appear in the curves. In other words, the curves show not the illumination between any two lights but the average for the block.

The area curves have per cent area of the street as abscissae. Thus, referring to curve sheet No. 7, one-fourth of the street is lighted (vertical illumination) by at least 0.165 foot-candles in the case of the tungsten cluster lights; 0.07, gem cluster; 0.04, enclosed arc; and 0.01, series tungsten. The data for these curves were derived from a large number of readings, some of which being taken on the center line of the street and on the center line of the sidewalk, appear in the distance curves. The derivation depends upon the fact that enough readings were taken regularly spaced over the entire block so that to each reading could be assigned a certain small area surrounding the station at which the reading was taken, each small area being, of course, a certain per cent area of the street. Hence the readings were arranged in descending order of their magnitude for ordinates and the corresponding per cent areas were progressively added for abscissae.

These same curves have often been obtained by plotting isolux curves and using a planimeter for obtaining the areas.

Examination for machinist is announced by the United States Civil Service Commission on March 20, 1911 to fill a vacancy in the position of machinist in the Signal Service at Large, Manila, Philippine Islands, at $1400 per annum. Applicants for this examination should be practical machinists, particularly experienced in the repair and construction of telephone, telegraph and electric-precision instruments.

DISCUSSION ON INDUSTRIAL POWER.[1]

The Electric Motor in Oil Well Service.

A. J. Bowie, Jr.: One of the questions Mr. Lamme brought up was the drilling of wells with rotary rigs. While these rigs work to advantage in soft formations, it is difficult if not impossible to use them when the formation is hard, in which event a drop drill should be used. The change from the Y to the delta connection for the motors is an interesting matter, as the higher field excitation will give a far stronger starting torque, and will enable a motor to deliver with advantage power considerably in excess of its normal rating for a short period. This results in nearly equalizing the copper and iron losses during the period of overload, and gives a rate of heating considerably below that which would obtain with the same load to be carried at the lower field excitation.

M. E. Lombardi: There is one question about the use of motors against gas-engines that I would like to ask about. The cheapest method of pumping wells, our company has figured, is a gas engine. Of course we get gas out of adjoining wells for nothing. Evidently the first year that will necessarily be cheaper than by the use of electric motors where you have to pay for the electricity. The second year it may be different on account of the large increase in repairs to the gas engine. Everybody knows that a gas engine is liable to have high maintenance charges after about a year's running, which the motors would not have, except for one thing. Down there in the oil fields, especially in the fall—they have tremendous wind storms raising large quantities of dust. It might be compared to a cement factory. And I would like to ask Mr. Lamme, or someone who has looked into the subject, what he has thought about that. The engine houses are loosely constructed, the high winds tear up the ground, and the dust comes in with tremendous power. I know that dust is commonly considered a great enemy to machinery. Has he thought anything about protecting the motors, whether by sealing the houses—which would cost considerable money—or protecting the motors themselves.

The question of maintenance is the main question between gas engines and motors, as long as the gas holds out. The gas engines are of higher cost to install, but they are of lower cost to operate so long as they are in good condition, and the gas holds out from adjoining wells. The question of dust storms would be the main thing as to whether the motors would have a high up-keep or not.

W. F. Lamme: I never thought of that. But I will say this: that we drive cement mills and stone crushing plants with motors. They require special bearings—dust-proof in many cases. The motor itself is not much troubled with ordinary dust. Cement dust is much worse than the ordinary kind. I don't think the ordinary dust would be much trouble. You must take the ordinary precautions to remove it once in a while.

M. E. Lombardi: If you put up a galvanized iron building and sealed it tight you would get rid of the dust; but in August the temperature is 120 outside and 140 inside.

W. F. Lamme: When you box a house up it is very bad for the motor. Some artificial means of getting air in should be furnished. We often see that in cases of deep wells, where it is rather close. I do not believe that it will occur in the oil fields of California. I do not believe that the dust is going to be so bad that it will be necessary. I think an ordinary house, with probably a screen on one side, would take care of the dust. If the worst should come we could build dust-proof bearings.

A. J. Bowie, Jr.: As to the protection of bearings from dust I have had a good deal of experience with motors running under similar conditions, and found it was a great help with vertical motors to filter the oil. I think some system of that kind might be devised for filtering the oil for the bearings.

S. G. Gassaway: I think Mr. Bowie is thinking of the oil that circulates in the bearings. As far as dust getting into motor bearings is concerned, when the electric motor is used in rock-crushing plants, I do not know of any place that is dustier than that, and we have no trouble with them.

Hugo Altmayer: We had some experience with motors out in the sand. We found by putting a tin can over the end of the bearings they ran along there about six months.

Electric Power for Gold Dredging.

J. W. White: Mr. Gassaway has taken up the question of the operation of dredgers with a head line, and also with digging spuds; and in this connection also spoke regarding the bucket ladder taking less power when digging at an angular position than when running idle horizontally.

To get around the undesirability of using a bucket ladder above or in the horizontal position, in a few instances a hydraulic giant has been mounted upon the bow of the boat, discharging water at the bank in order to break down that portion above the water line, so that it is caught by the buckets when digging at the bottom of the pond. The water for this giant is furnished by a multi-stage centrifugal pump, motor driven. By breaking down the bank by means of a hydraulic jet the daily yardage of the dredger is considerably increased without a greater total of power output; and the strains which are consequent upon the position of the ladder "when digging on the horizontal and in some instances above the horizontal when the bank is high" are eliminated.

Referring again to the head-line method of operation it is common practice to anchor a "dead man" four or five hundred feet ahead of the dredge, and the dredge swings on an arc with a radius equal to the length of the cable ahead. This method is usually employed in soft ground, and while it is cheaper in operating expense, is not as economical from the point of gold saving. The reason for this is that there is so much slack in the cable that the dredge does not dig on a true arc on account of soft spots in the ground, and more of the ground is lost than with a spud. If the ground is uniform and soft, however, this method may be successfully used.

If the dredge uses a spud in digging there is greater certainty of each bucket getting its proportion of the soil, and in hard grounds is much more satisfactory. The dredge has two spuds, one of which it digs on, and the other is only used with moving ahead.

In moving, the dredge is swung to the extreme end of the arc while on the digging spud; the moving spud is then dropped and the digging spud raised, and the dredge then swung to the opposite end of the arc. At this point the operation is reversed, and the dredge starts ahead on a new cut. It is therefore seen that the method of moving up is similar to a walking motion.

A number of tests have been made on different dredgers regarding the direct gearing of the motor to the bucket line, and it has been practically demonstrated that the strain on the gears at certain points is so great that general practice has reverted to belt drive again.

[1] San Francisco Section A. I. E. E., March 24, 1911.

BOOK REVIEWS.

Applied Thermo-Dynamics for Engineers. 438 pp., 6x10, 316 illustrations. By William D. Ennis. D. Van Nostrand Co., New York, and Technical Book Shop, San Francisco. Price $4.50.

This work is a technical treatise, covering the application and use of heat and heat engines. In the first eight chapters, the subject matter covers broadly the theoretical laws governing the nature and effect of heat. This section is divided into various groups, beginning with a study of heat units and specific heat and the laws of gases. Graphical representation of cycles and expansions are treated with considerable detail and a profusion of diagrams. The subject of entropy, so elusive to the lay mind is given an entire chapter and a mathematical treatment. The remainder of the book has many applications, beginning with the subject of compressed air with much valuable matter of a theoretical

nature. Hot air engines fill space that is conspicuously absent in older works covering this theme. The subject of gas power, producers and engines occupies 52 pages; it is complete and up-to-date and especially so in the number and variety of engines which is treated. The theory and design of the steam engine and turbine from the thermodynamic standpoint is most complete and supplies all of the information that one might require from a text or reference book. Finally, refrigeration and liquid-air are taken up with the same aim to thoroughness as is evinced throughout the entire work. Covering a broad and difficult subject with clearness and completeness this should be a satisfactory text book for the advanced student and a valuable reference for the engineer.

Design of Multitubular Boilers. 48 pp., 6x10, 15 plates. By James D. McKnight and Alfred W. Brown. D. Van Nostrand Co., New York, and Technical Book Shop, San Francisco. Price $1.50.

The subject of marine boiler design is one of the greatest commercial importance and yet it is, technically one on which little can be said outside of the set rules laid down by long construction experience; this is particularly so when reference is made to one particular type of boiler, as is the case here. The best idea of the object of the book can be had from the first few lines of the preface: "This treatise has been issued for the use of those engineers and draughtsmen whose experience has been wholly or mostly on engine work, but who are anxious to learn something of the boiler side of the business." The quantity and completeness of the information contained in this book, on the multi-cellular type of marine boiler, following English Survey requirements of the Board of Trade, Lloyds and the British Corporation, at once shows its value. The book is well supplied with outline and detail drawings for standard specified sizes and pressures, and should appeal, not only to the marine engineer, but to the designer and constructor. General discussion of theory and practice has been carefully avoided; the subject matter is concise and all calculations are arithmetical or in the simplest algebraic form. As a hand-book this little work, within its limited field, should be of great value.

Continuous Current Machine Design. 240 pp., $5\frac{1}{4}$x$8\frac{1}{2}$, 137 Illustrations. By William Cramp. D. Van Nostrand Co., New York, and Technical Book Shop, San Francisco. Price $2.50.

Direct current is so generally used in every industry and for every purpose, and the rules and laws of its operation are so simple and obvious in comparison with those governing the use of alternating currents, that we spend most of our energies when making calculations to the study of the latter. Every year new treatises are written and much is said to advance our general knowledge of alternating current machines and transmission. On the other hand, the very simplicity of direct current machines and their use precludes the necessity of saying much that is new. For this reason, the details of what is really a highly developed science invariably get brief treatment, whether it be in text books on electricity or even handbooks. The manufacturers of direct current machinery have their own carefully worked out designs and the results of their testing and experimenting; but a treatise on the design and detail of this type of machinery is a book of which there has been a long felt need. This new book covers the subject in minute detail, the treatment throughout evinces the result on the part of the author of careful study and research with the object of supplying the reader with matter at once concise and sufficiently complete to give a full and comprehensive understanding of both, calculation and design. The book avoids the time-worn practice of illustrating a few typical machines which the technical reader has seen many times before, but is profuse in carefully worked out drawings and diagrams to properly illustrate the subject matter. The author opens with a chapter on the form of modern machines, which is followed by chapters on armature and magnet calculations. A chapter on temperature rise is of unusual value. The subject of armature winding while technically interesting is not particularly new, but the chapter on commutation is in itself worth the price of the book and should appeal to any electrical engineer or operator. Construction and design are comprehensively treated, both graphically and mathematically, and considerable attention is given to costs. The latter data apply to conditions as found in England as also does many of the details shown. The mathematical development of the theory is segregated in the appendix. The book is well worth a place in any engineering library and as a hand-book should be of value.

NEW CATALOGUES.

Bulletin No. 131, descriptive of the installation of the "Chloride Accumulator" for the Lake Hopatcong Yacht Club.

In Bulletin No. 4812, just issued by the General Electric Company, are described small direct current generators ranging in capacity from $1\frac{1}{4}$ to 20 kw.

The Westinghouse Electric & Mfg. Company has just issued a catalogue section on its Type S and SA distributing-transformers for light and power service up to 3800 volts.

The General Electric Company had recently issued a new Bulletin, No. 4811, describing its drum controllers. This bulletin contains descriptive matter and data in considerable detail, and supersedes the company's previous bulletin on this subject.

The January-February, 1911, Bulletin from the Ohio Brass Company contains valuable notes on coupling electric railway cars, a description of the new O-B extended trolley car, suggestions in the choice of high tension insulators and interesting data on mine haulage installations.

Bulletin No. 4813, just issued by the General Electric Company, describes an oil break switch adapted to use on alternating current series arc systems for sectionalizing feeder systems, cutting in and out transformers, and similar classes of service requiring a switch to be operated under load.

The General Electric Company recently issued Bulletin No. 4787, which is devoted to the subject of Wires and Cables. The publication should be of considerable service to purchasing agents, central station managers, and all having occasion to buy or use wire and cable for any service. The book contains much data but no prices.

"Electric Meters: How to Read Them," is the title of a very attractive and instructive booklet just issued by the Westinghouse Electric and Manufacturing Company. As the title suggests, the booklet is intended as an instruction in the reading of watthour meters for the layman. It is written in a popular style, easily understood by anyone.

The General Electric Company has just issued a revised Bulletin, No. 4791, which supersedes its previous bulletins on this subject, "Feeder Voltage Regulators." The bulletin describes the Company's regulators of the induction type and switch type, single and polyphase, hand operated and automatically operated. It contains connection and dimension diagrams, together with weights of the various regulators described.

The Westinghouse Electric & Mfg. Company has just issued sections 804, 805 and 806 of its detail catalogue. The new sections describe the complete line of insulating materials recently placed upon the market by this company. The lines described include treated and untreated cloths and papers for insulating purposes, and insulating and soldering fluid, including shellacs, varnishes, soldering acids, soldering paste, glue, cement, etc.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas" Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Transmission Line Stability

It is of interest to note the steady improvement which has been made in line construction for the long distance transmission of power, during the last decade. The results of operation, with this branch of electrical science more perhaps than any other, are necessary to approve theories of proper design, and line practice has gradually evolved from that borrowed from the telegraph and telephone standards to a remarkable individuality of its own.

The past winter, during which an unusual amount of rain has fallen, and even yet continues, has been a most severe test on electrical transmission. In spite of this, there has, taking an average, been less interruption to continuous operation than ever before and it can only be attributed to the fact of the standard quality of work, materials and design at present in vogue.

Anti-License Jargon

We often hear of the power and educational value of the daily press and the evidences of both the good and the bad that it accomplishes are to found on every hand. Unfortunately even the well meaning may become an advisor with insidious influence, because of a painful ignorance of simple affairs, of those things which permeate our every day life, and too often go unnoticed. This very condition should give to the ordinarily intelligent person, some power of observation.

An example of well meaning but inexcusable hogwash, appropos the bill on the licensing of stationary engineers now pending before the California Legislature, appeared in the ordinarily conservative Chronicle during the past week.

The following remarkable extracts on the subject of explosions of small boilers is illuminating:

> Whoever hears of the explosion of one of these simple steam boilers ——? There are virtually no such accidents.

Could anything be more childlike. The experienced statistician would make considerable research before he would have the temerity to utter such statements and, if he, in his studies, should delve into the columns of the paper in question would perhaps find enough data to preclude such a possibility. Again:

> It is improbable that in one of these boilers sufficient steam could be generated to cause an explosion and at any rate on all boilers, there is a safety valve

No, brother, the millenium has not arrived; boilers will still explode if you let them. Perhaps you may see the time when they will not because you will have no need for steam or boilers; meanwhile our boilermakers are still busy.

But why abuse the safety valve, it has a heavy responsibility as it is, like other human productions, it does not inherit from its creator any claim to infallibility. Why not print over railroad time-tables: "All trains are guided to their destination on two rails, hence the impossibility of an accident"? Lastly:

> A licensed engineer is no more competent to run one of these ordinary hoisting engines, than any other sensible man.

The licensed engineer really has to have sense and he doesn't wear horns. Why not license the sensible man and there will not be so much chance of drawing

a blank? There are many readers equally as unobserving as the writer of these excerpts, who will become educated to this lop-sided reasoning, and it is more the pity because they and they alone will be the sufferers thereby.

Recall of the Judiciary

The Journal cannot but feel some sense of shame and regret over the action of the California Legislature in the matter of the recall of the judiciary. Here is a body of men that is the boasted result of our first direct primary. Its members were direct from the people. They were for the first time in the State's history, nominated by the people, elected by the people, and if ever a legislature should have spoken for and had full confidence in the people it was this one. After a spirited debate in which men of unquestioned honor and integrity appeared before the legislators in opposition to the recall of the judiciary, this body answered in favor of the recall. It was pointed out to the legislature that there was a healthy division of opinion among the people as to the wisdom of including the judiciary within the recall provision. And it must be said these protestants had much the better of the argument. The legislature was asked to submit the constitutional amendment in such a form that the people who believed in the recall as a general proposition might vote to the recall as applied to the judiciary might vote for it, and so that those who were opposed, in principle, against that proposition. One of the chief arguments of the proponents of the recall is that "A people who can be trusted to elect judges can be trusted to recall them," and yet this people's legislature loudly claiming that they were representing the people and that a majority of the people wanted the power to recall the judiciary, stubbornly and suspiciously tricked the people out of the right to vote on that proposition as a single proposition. Denied the people the right to say what they wanted. This "people's legislature" has refused the people the right to express their unbiased opinion on a question of vital importance.

It is difficult to conceive what defense the recalcitrant members of this legislature can make to the charge of dishonest trickery. They have acted like fools bent on the destruction of the reform they misrepresent. They confess lack of confidence in the people; they give the lie to their own claims; they tell the public to take the recall as to all officers or to leave it alone. They tell the people the voters are fools and don't know enough to discriminate, and they consolidate a proposition that has the full approval of the people, with another proposition upon which the people are divided and say in effect "You can't get what you want unless you take something else you don't want."

These sort of tactics make thinking men sick and disheartened, and force the question, "Is this sort of reform any better than the machine dominance we have left?"

In every civilized country in the world the judiciary is supposed to be independent of the sovereign. Recently it was charged—but as to the truth of the charge we know nothing—that by a star-chamber proceeding under the direction of the Emperor of Japan, a number of socialists were executed without a fair trial and a shudder went around the world. What is the difference between a court dominated by an emperor and a court dominated by a majority of the people, or a court dominated by a fear of the recall. The mere threat of a recall would not disturb the judgment of a brave and honest judge, but no brave and honest man would care to put himself in a position where he would be subject to the recall, no matter how unmerited the movement for a recall might be.

The result may not follow immediately, but it will eventually, that cheap and shallow men will seek the bench. We will then have judges, not deciding the law as they find it, but trimming a statute down here or amplifying and enlarging it there to meet what they may consider the popular conception of the law. When this day comes God help the country.

When the lowly Nazarene was dragged into the Hall of Judgment for examination, Pilate, after questioning Him refused to pass sentence, saying, "I find Him in no fault at all." There was no referendum in those days and no recall of the judiciary, but it was during the Passover and the people were entitled to the release of one prisoner during this feast. Washing his hands of the whole affair, disregarding his own conclusions based upon the law and the evidence, in answer to the demands of the populace he permitted the people to write the judgment of the court.

"And Pilate gave sentence that it should be as they required." "Take ye Him and crucify Him, for I find no fault in Him."

Here you have the first historical record of what results from yielding the judgment of the courts to the wishes of the people.

There is something so monstrously wrong involved in the recall of the judiciary that it seems as though thinking men who advocate it had for the time forgotten to think. This is no mere question of voting out of office a bad man whom you have voted in. To oppose it is not to declare that a people who have elected a public officer are unfit to remove him if he prove unsatisfactory. These questions, if they be questions at all, are far removed from the real issue. The only shield that stands between human liberty and the passions of men is the judiciary. Against this scutcheon every lawless force that curses free America has been battering for years. If they can break down this defense, if they can make noisy clamor and angry shouts and protests dictate the opinions of the courts then farewell to a stable form of government, farewell to liberty as we have known it. "But the honest and courageous judge will decide just as he would decide now." Honest and courageous judge! There will be none left. The only judge who will ever be the subject of the recall will be the honest man who dares do what he thinks is right despite the clamor. Honest and courageous men will no more seek the bench than would an honest and courageous man willingly put himself in a position where, innocent of crime, he could be charged with criminal offense. The men who would seek the bench would be the kind who never would be recalled. No man's legal rights or remedies would be safe in such hands.

PERSONALS.

A. J. Turner, engineer for the San Dimas Quarry Company of San Dimas, Cal., is at San Francisco.

H. C. Stoddard, superintendent of the Rogue River Electric Company of Medford, Ore., is at San Francisco.

Frank Somers, manager of the Century Electric Company of San Jose, was a San Francisco visitor this week.

H. C. Strong, president of the Ketchikan Electric Light & Power Company, of Ketchikan, Alaska, is a San Francisco visitor.

G. R. G. Conway has been appointed chief engineer of the British Columbia Electric Railway Company, Vancouver, B. C.

Thomas Mirk, of Hunt, Mirk & Co., returned last week to San Francisco after a trip to San Diego on engineering business.

C. R. Ray, president of the Rogue River Electric Company, has returned to his home at Medford, Ore., after making a tour of California.

Henry Doerr, who is interested in the California Electrical Construction Company of San Jose, recently visited the San Francisco branch.

F. F. Barbour, who recently became assistant to the president of the Pacific Gas & Electric Company, visited Sacramento during the past week.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company of Milwaukee, Wis., is paying a visit to the San Francisco office of the company.

Benjamin Cunha has made application to the Board of Supervisors for permission to install an electric lighting plant for commercial business at Half Moon Bay, California.

E. C. Bradley, vice-president and general manager of the Pacific Telephone Company, has returned to his San Francisco office, after a Southern California inspection tour.

H. F. Dodge, division commercial superintendent of the Western Union Telegraph Company, has been at San Diego with a view to selecting a location for a new telegraph office.

W. H. Holabird of Los Angeles, who is receiver of the California Development Company and is interested in electric power enterprises, arrived at San Francisco from the East last Monday.

C. H. Gaunt, general superintendent of the Pacific division of the Western Union Telegraph Company, who is convalescent after a severe illness, recently went to Santa Barbara to recuperate.

W. R. Alberger, who is vice-president and traffic manager of the Oakland Traction, Consolidated, and a director in the United Properties Company, has gone to New York on business for the new holding corporation.

H. M. Byllesby, president of H. M. Byllesby & Co., of Chicago, recently arrived on the Pacific Coast to look over the various electric power and lighting plants owned by the Byllesby corporations in Oregon and California.

Oakey Meadows, who was for a number of years a Southern Pacific train dispatcher and later held a position with the Ocean Shore Railway, has been made chief solicitor of the Western Union Telegraph Company at San Francisco.

George Washington Ferrier is the electrician of the new Scottish Rite Temple, which was opened last week on the corner of Van Ness avenue and Sutter street, San Francisco. It is a large stone structure of six stories equipped with lighting fixtures of the latest type. There are also ingenious special lighting effects, which are made use of in connection with the lodge work.

ITINERARY FOR ELECTRICAL JOBBERS' TRIP TO DEL MONTE.

The outgoing route to Del Monte, California, will be via the Santa Fe and Southern Pacific (Coast Line), on the train known as the Electrical Supply Jobbers' California Limited.

Date. April.	Day.	Day of Week.		
			Via A. T. & S. F. Ry.	
18th	1st	Tuesday	Lv. Chicago	8:00 P. M.
19th	2nd	Wednesday	Lv. Kansas City, Mo.	9:10 A. M.
19th	2nd	Wednesday	Lv. Newton, Kans.	2:15 P. M.
19th	2nd	Wednesday	Lv. La Junta, Colo.	10.55 P. M.
20th	3rd	Thursday	Ar. Albuquerque, N. M.	11:05 A. M.
20th	3rd	Thursday	Lv. Albuquerque, N. M.	12:00 M.
20th	3rd	Thursday	Ar. Laguna, N. M.	2.00 P. M.
20th	3rd	Thursday	Lv. Laguna, N. M.	3:00 P. M.
21st	4th	Friday	Ar. Grand Canyon, Ariz.	6:00 A. M.
21st	4th	Friday	Lv. Grand Canyon, Ariz.	7:30 P. M.
22nd	5th	Saturday	Ar. Los Angeles, Cal.	2:30 P. M.
23rd	6th	Sunday	In Los Angeles, Cal.	
			Via S. P. Ry., Coast Line.	
24th	7th	Monday	Lv. Los Angeles, Cal.	8:00 A. M.
24th	7th	Monday	Ar. Del Monte, Cal.	9:11 P. M.

Round trip tickets Chicago to San Francisco via the Santa Fe line and Southern Pacific, westbound, and returning via Route Nos. 1, 2, 3, 4, 5, 6, 7, 8; $79. This includes side trip to the Grand Canyon. Returning via Route Nos. 9, 10, 11, 12, 13; $94. Pullman fares with stop-over at the Grand Canyon and Los Angeles, thence to Del Monte, are $18.50 for lower berth from Chicago.

Special round trip fares to Pacific Coast points, leaving Chicago April 18, 1911. Dates of sale, Chicago, April 18, 19 and 20, 1911. Final return limit, June 30, 1911.

From	To Los Angeles, San Francisco, San Diego, via direct routes.	To Los Angeles, San Francisco, in one direction via Portland or Seattle.
Chicago, Ill.	$72.50	$87.50
St. Louis, Mo.	70.00	85.00
Omaha, Neb.	60.00	75.00
St. Joseph, Mo.	60.00	75.00
Kansas City, Mo.	60.00	75.00
Sioux City, Ia.	63.90	78.90
St. Paul, Minn.	73.50	81.75
Minneapolis, Minn.	73.50	81.75
Memphis, Tenn.	70.00	89.65
New Orleans, La.	70.00	92.50
Denver, Colo.	50.00	65.00

For side trip to the Grand Canyon add $6.50.

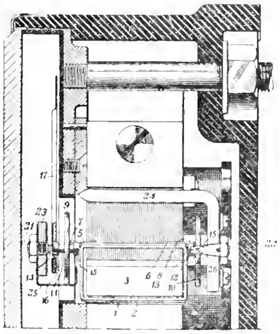
Going trip from Chicago must commence on day of sale; return trip must commence on date and train stamped on validation certificate. When presented in person by the original purchaser to the validating agent, tickets will be validated not to exceed one day in advance of departure. All tickets must read Chicago to San Francisco and return. The going coupons being "Santa Fe, Chicago to Los Angeles; S. P. R. R., Los Angeles to San Francisco."

Special rates are offered by the Hotel del Monte for the annual session Electrical Supply Jobbers' Association, April 25, 26, 27, 1911. Reservations will be made in the order received at the hotel office for accommodations which are available as follows: 32 single rooms without bath on fifth floors of annexes at $3.50. 52 rooms with and without bath on fourth floors of annexes at $4, one in a room, no bath; at $7, two in a room, no bath; at $4.50, one in a room, with bath; at $8, two in a room, with bath. 25 rooms without bath, main building back, at $4, one in a room; at $7, two in a room. Rooms with and without bath on first, second and third floors of annexes and second and third floors, main building, at $4.50, one in a room, without bath; at $8, two in a room, without bath; at $5, one in a room, with bath; at $9, two in a room, with bath.

A round trip to Yosemite Valley is offered at a flat rate of $28.65 by the Southern Pacific Company if a party of 125 is formed. This rate includes Pullman fare both going and coming and special train both going and return trips, all meals, sleeping accommodations while at El Portal and in the valley, and would permit members of the party spending three good days in the valley.

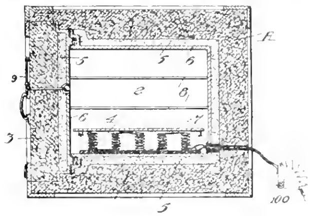
PATENTS

985,456. Electrical Measuring Instrument. Maurice C. Rypinski, Pittsburg, Pa., assignor, by mesne assignments, to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. An instrument pointer formed from sheet material



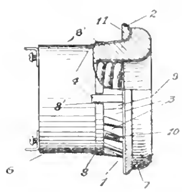
and comprising a channel-shaped index-carrying arm, and a base having a seat or recess in one side to receive a supporting member, and recesses in said base to receive material for balancing the pointer.

985,144. Electric Oven. James V. Chown, Oakland, Cal., assignor of one-sixth to R. Porter Giles, one-sixth to William S. Cox, one-sixth to J. Clem Ady, and one-half to Jessie Marian Chown, Oakland, Cal. An electric oven comprising a shell embodying a mixture of diatomaceous earth, sawdust and lime,



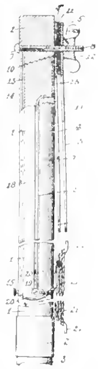
and having its interior lined with a coating of fire-clay, said composition and lining inclosing an oven chamber, a door of like composite material similarly lined closing said oven chamber, an electric heating coil for the oven, with means for regulating the amount of heat from the outside.

985,395. Lamp-Socket Fastening. Hjalmar Christensen, Seattle, Wash. A lamp socket fastening comprising a hollow body portion provided at one end portion with relatively long



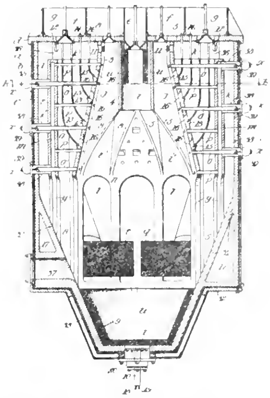
and short fingers, the longer of said fingers being pliable whereby they can be bent outwardly to oppose the supporting element for the lamp socket, and a shoulder on said body portion co-operating with the last named of said fingers to secure said body portion to the supporting element for the lamp socket.

985,127. Portable Telephone-Pole. George J. Bayless, Oakland, Cal. A portable telephone-pole comprising a pole; a pair of conductor arms pivotally connected with the head of



the pole and adapted to be extended from opposite sides thereof, said arms being electrically insulated from each other; and circuit wires leading from said arms.

985,226. Electric Smelting Furnace. Edward R. Taylor, Penn Yan, N. Y. An electric smelting furnace of the stack type having, in combination, a suitable hearth, a superstructure of suitable heat-resisting material inclosing a working chamber above the hearth and constructed with a cylindrical upper feed portion including a cylindrical outer wall and cylindrical walls concentric therewith forming between them



vertical feed passages for heat-conserving streams of ore on its way to the heat zone, a central circular wall inclosing a vertical flue-shaped coke passage and a downwardly flaring circular wall separating inner and outer ore passages surrounding said coke passage, and horizontal electrodes extending into the working chamber immediately above the hearth; said passages discharging in common into the working chamber by gravity.

INDUSTRIAL

O-B EXTRUDED TROLLEY EARS.

In the Extruded Trolley Ear which The Ohio Brass Company of Mansfield, Ohio, have just placed on the market, we feel warranted, by the unprecedented results secured by its use in severe trial service, in believing that we have at last found that for which railway men have been searching since the inception of overhead trolley, viz:—a means of greatly reducing the expense of trolley ear maintenance.

A glance at the accompanying illustration shows that the extruded ear consists of two pieces, a runner piece and a boss.

The boss is made of malleable iron, galvanized, and is pressed upon the runner piece and then securely riveted in place.

As the name would imply, the runner piece or portion which grips the trolley wire is made of extruded metal, which is a unique and most superior feature of the ear. A brief description of this extruded metal of which the runner piece is made, and how it is produced, will greatly aid in perceiving the good qualities of this trolley wire support.

A billet of pure cast bronze is placed in a furnace and heated to a bright red heat after which it is taken out and immediately inserted in a very thick walled, laminated steel drum having a tungsten steel die clamped against the opposite end of this cylindrical drum.

This die has an opening in it exactly the shape of the section of extruded metal device which it is desired to produce and both the steel drum and tungsten steel die are especially designed to withstand enormous pressures at high temperatures.

A hydraulic ram is brought to bear upon this red hot billet of cast bronze forcing it out through the die under several tons of pressure. The metal, as it emerges from the die, is cooled rapidly by a very strong blast of cold air.

It can readily be seen that sections thus produced must be absolutely uniform in dimensions, and in the structure of the metal as metal so treated can not have any blow holes, cracks, checks or "rotten spots" which are sometimes found even in the very best of cast bronze material.

Referring to the physical properties of extruded metal we might state that it is due to this ingenious process of extrusion and not to the composition of the metal that the sections which we are putting into our ears have a tensile strength of 70,000 lbs. per square inch, an elastic limit of about 50,000 lbs. and an elongation of 33 per cent.

The above physical properties as given, coupled with the additional positive assurance that the sections must come absolutely true in dimensions, having a perfectly smooth surface for gripping the trolley wires, makes the metal peculiarly adapted for use as a trolley wire support.

Due to the fact that the metal is perfectly uniform as to physical structure and also that it has such great strength we are able to keep the lips of the extruded section which grip the trolley wire, very thin so that they offer the least amount of obstruction to the passage of the trolley wheel, thus minimizing the arcing of the trolley wheel when passing directly under these supports. Furthermore, this metal is capable of being easily hammered down to a perfectly smooth fit around the trolley wire without leaving crimps or bumps which would cause a continual chattering of the wheel in passing under them, as is often the case in cast ears.

The foregoing statements are based on actual experience and not alone on theory. We have been trying out this metal for sufficient time to make it absolutely certain that it would bear out in practice the superior points which it seemed to have in theory.

The practical installations we made proved conclusively that this ear has an exceptionally long life and furthermore that it causes less wear to trolley wheels than other supports.

Examinations of extruded ears that have been up for several months under the two-minute car service showed that the lips of these ears were tightly closed around the wire so that it was impossible to detect the actual joint between the lips and the trolley wire. Furthermore, the ends of the ears were found to grip the wire just as well as the central portion, instead of curling up as is often the case in cast ears.

One other advantage which is gained is the elimination of the possibility of the stripping of the threads in the malleable iron boss which often occurs in the bronze ears.

The malleable iron boss does not at any time come in contact with the trolley wheel, so it can not cause arcing.

O-B Extended Trolley Ear.

Extruded ears are installed exactly in the same manner as any regular clinch ear and the lips are regularly furnished not tinned, but can be tinned if so ordered.

Any railway man will appreciate the fact that the extruded ear, due to its exceptionally long life will mean a great saving in his maintenance expenses, and due to its ductility and perfect fit it can be more quickly installed and will cause less wear to the trolley wheel.

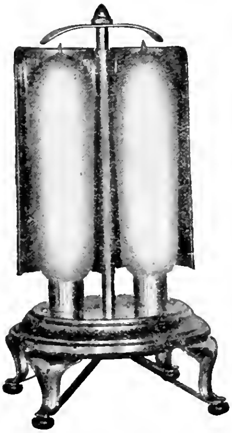
TWIN-GLOWER ELECTRIC RADIATOR.

Until it becomes customary to include special heating circuits in the wiring of our homes, the most successful heating devices will be those which are readily attachable to the lighting circuits in place of a lamp. In the twin-glower electric radiator recently developed by the General Electric Company, the feature of ready applicability appears to have been given first consideration in that the heating elements are designed for a maximum energy consumption of 500 watts, thus permitting the operation of the radiator on any lighting circuit.

It is noteworthy that in this case the feature of ready applicability has been obtained without sacrificing in the least the various well known advantages of the luminous type of radiators. The same "non-oxygen consuming" radiant heat so essential to hygienic conditions not only in the sick rooms of homes and hospital wards, but also for safeguarding the general health of any household is available, while extreme lightness of weight permits of the radiator being easily moved from room to room or to any other desired place. Thus it can be readily used for increasing the temperature of the bath room preparatory to the bath, for making the bedroom comfortable in the early morning when the regular heating system has a low tone, and for adding to the comfort of reception halls, libraries, studies, and other rooms, which usually are of temporary occupancy. Furthermore, the absence of

carbonic acid producing open flames renders its use particularly desirable in rooms containing valuable paintings and beautifully bound books, which rapidly deteriorate when exposed to injurious burnt gases or products of combustion.

The campaign of education on the advantages of electrical household devices has been prosecuted so successfully, that it is hardly necessary to repeat its many familiar and valid statements, yet any facts relative to the economy of these devices always are of vital interest to prospective users. In other words, they always like to know the price of a device and the cost of operation.



Twin-Glower Electric Radiator.

The price of the twin-glower electric radiator is only about a third more than that of the popular six-pound electric flat iron, and its cost of operation is about five cents an hour at the usual central station charge for current. It is, therefore, within the reach of all who desire to avail themselves of many comforts which are unobtainable economically by any other means.

Since these devices are only used for fractional parts of an hour, the monthly expense is comparatively small. Two and a half cents for protecting the baby from dangerous cold draughts during the bath is hardly more than the cost of the talcum powder dusted on the rosy skin, and about the same amount for comfort while getting up in the morning, thereby avoiding the necessitiy of starting the furnace an hour or two before breakfast certainly is a small item compared to the benefits enjoyed. Furthermore, the desired heat is as everready for use as the brilliant rays of the beautiful Mazda lamp in the chandelier—requiring the mere turn of a switch to pour out in full intensity.

It is generally recognized that only a single trial is required for permanently establishing the electric flat iron, radiant toaster and disk stove as household necessities; likewise only one trial is all that is needed to add the twin-glower electric radiator to the popular trio.

THE IRON LOSS VOLTMETER.

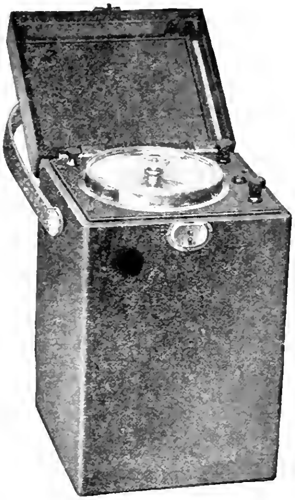
The standardization rules of the American Institute of Electrical Engineers provide that in determining the ratings of alternating current machines or apparatus, a sine wave of alternating current and voltage is assumed. This suggestion has been adopted by practically all manufacturers as a basis for temperature and performance guarantees. The reason is obvious. The wave shape affects the iron loss and, therefore, the general performance of most apparatus. Practically every generator, except those designed particularly to give a true sine wave of voltage will produce a wave shape different from that produced by every other generator; and even with those designed to produce sine wave voltage at their terminals, the circuit will likely distort the wave so as to cause it to vary considerably from the true sine.

As it is impossible to make guarantees that will apply to all wave shape, and as there is no simple way of designating any wave shape other than a sine wave, the sine wave of voltage has been adopted as a standard in order that results may be compared intelligently.

Difficulties arise in attempting to correct test results for the deviation of the actual shape of wave used from the true sine shape. The actual shape of the wave requires special apparatus to determine and must be redetermined for every test, as the constants of the apparatus tested change the shape of the wave. After the wave shape is determined, the form factor must be found, a complicated calculation. Hysteresis loss is affected by the wave shape, while eddy current loss is not, which makes it necessary to separate these losses before the form factor correction can be applied.

Another factor affecting results to a large extent is the frequency of the testing circuit, and the correction for it is difficult. It is almost impossible, particularly where tests are made at a substation, to bring the frequency to normal, and consequently a large error in actual and comparative results may be introduced.

To get around these difficulties and provide a simple method of making transformer tests which are correct for normal frequency and sine wave shape voltage, the Westinghouse Electric & Manufacturing Company, of Pittsburg, has recently placed on the market the iron loss voltmeter, an instrument that is invaluable to a central station or laboratory requiring tests on transformers in terms of pure sine shape voltage and normal frequency. The purpose of the instrument is to make possible the adjustment of the voltage of a circuit of any voltage wave shape, and frequency above or below normal, to such a value that the effect is the same as



The Iron Loss Voltmeter

that of normal voltage of sine wave shape and normal frequency. By the use of this voltmeter and any convenient means for varying the voltage of the testing circuit, practically any wave shape of voltage or frequency error can be compensated for in the test. This is accomplished by setting the index pointer of the iron loss voltmeter for the normal voltage at which test results are desired, and then adjusting

the voltage by means of a rheostat or other device until the moving coil pointer is on the zero mark.

It will be apparent that this method does not produce a true sine wave voltage of normal value, nor does it change the wave of the applied voltage, but it compensates so that the effect on the iron loss is the same as the normal sine wave would produce.

This method of testing is extremely accurate. The A. I. E. E. rules permit a deviation of the wave shape from the sinusoidal shape of 10 per cent, but this deviation is intended as a limit for the wave produced by apparatus guaranteed to produce a sine wave, and is not intended as a basis for tests. It has been shown that tests made on various wave shapes within the limits of the nominal sine wave may vary as much as 7.8 per cent above and 5.8 per cent below what would be obtained with actual sine wave voltage. It is evident, therefore, that tests made on any wave shape should be corrected to actual sine wave values. In making such correction by means of oscillograms, it has been found that tests obtained on different wave shapes give results the best of which vary as much as 2½ per cent. With the iron loss voltmeter a large number of tests of different transformers on a variety of commercial wave shapes show that the result obtained varies not more than one per cent from the result obtained on true sine wave and normal frequency. The time required for the test is also reduced to a few minutes.

In addition to the possibility of making iron loss tests on transformers and other inductive apparatus intended for connection in multiple with the circuit, the iron loss voltmeter can be used to determine normal exciting current and for making a reliable heat run. The normal exciting current is determined by correcting the shape of the wave by any convenient means until the iron loss voltmeter and an ordinary root-mean-square voltmeter indicate the same voltage. The voltage wave then has the same form factor as a true sine wave, and by suitable correction for frequency the normal exciting current is determined.

In making a heat run, the voltage is adjusted as in the iron loss test, until the iron loss voltmeter reads normal voltage, with full load current in the apparatus. Under such conditions both the iron loss and the copper loss are normal, and the results of the test can be depended on as representing the normal performance of the apparatus.

The advantages of this system of testing must appeal to every central station man operating a plant of any size. It permits simple tests to check the claims of manufacturers and to compare competing apparatus before purchase.

CEMENT THAT WILL STAND 3000 DEGREES F.

For many years engineers have experienced great difficulty in proper maintenance of brick settings of furnaces of all types. They have been compelled to depend upon the ordinary fire clay as a bonding material, and as this fuses at a comparatively low temperature, the bond between the bricks is rapidly destroyed and the result is that the cracks are opened up between the bricks, through which the gases of combustion enter, eventually weakening the brick and causing the walls to collapse. Every engineer realizes the annoyance and expense occasioned by occurrences of this kind.

Another feature which has been objectionable is the fact that refractory bricks become very porous on the surface and very soon the clinkers from the coals attach to the surface of the brick and in removing these with tools, the bricks are broken.

After several years devoted to research work on refractory cements to overcome these troubles, the H. W. Johns-Manville Company, New York, are now offering to the trade, a line of cements called J-M Refractory Cements for furnace setting of various types, cupolas, lining brass furnaces, assayers crucibles, oil burning, tilting and rotary furnaces and for patching and facing bricks in place in the fire zone under various conditions. These cements are rated to resist temperatures as high as 3000 deg. F.

They have also produced a coating for walls known as J-M Brickline Cement, which prevents clinkers from adhering and to seal the pores of the brick. Realizing that the conditions under which these cements are used, are variable, they have been made capable of modification to meet conditions as they come up and the Johns-Manville Company invite the trade to place before them any conditions that are troublesome and they will be very glad to make a careful investigation and offer suggestions which will tend to overcome the difficulty.

TRADE NOTES.

The Detroit Electric for 1911 is attractively illustrated and described in a handsome catalogue from the Anderson Electric Car Company of Detroit, Mich. This brochure is replete with fine half-tones and is well printed in two colors.

The Mt. Hood Railway & Power Company has been awarded the contract for furnishing electricity to the new Balfour-Guthrie Company mill at Portland. The mill will have a complete single drive motor installation and will use about 500 h.p.

The City Railway Company of Los Angeles has purchased from the General Electric Company the following machinery and other equipment: Two 1000-kw., 2-unit, 2-bearing motor-generator sets; one 2-unit, 3-bearing, 600-kw. motor-generator set; six 475-k.v.a., 15,000-2350-v., water-cooled transformers; three 300-k.v.a., 15,000-2350-v., water-cooled transformers.

R. E. Starkweather, contractor for transmission line construction, has completed the transmission and telephone line between Monterey and Salinas and between Salinas and Spreckels. His contract for the trolley and telephone line construction of the Oakland and Antioch railroad is well under way, Mr. Starkweather also superintending the actual construction of the road.

U. S. Judge Coxe of New York has issued an injunction against the Independent Electrical Supply Company of that city, restraining them from handling or disposing of a line of switch boxes manufactured by the Economy Switch Box Mfg. Co., of Cleveland, Ohio, these boxes containing knockout plugs which it was claimed infringed the Bossert Company's Patent No. 571,297, which was sustained by the Circuit Court of Appeals in June, 1910.

A. C. Downing, formerly sales manager of the Waverly Company, and at one time with the Studebaker Company on the Pacific Coast, has recently been retained by the Anderson Electric Car Company. Mr. Downing brings a broad knowledge and experience to the Anderson organization, having been actively engaged in the electric car business for more than nine years. Mr. Downing will be in charge of the commercial vehicle department of the Detroit Electric.

The Westinghouse Electric & Mfg. Company of Pittsburg, Pa., has recently placed upon the market its complete line of standard insulating material products. This includes both treated and untreated fabrics and papers, a complete line of friction tapes and rubber splicing compounds, together with the various types of insulating glues, cements and gums, all of which are used in its works at East Pittsburg, in the manufacture of their standard electrical products. Attractive sample books, Nos. 804-X and 805-X, together with Folder 1181, have been issued and may be obtained from the various offices of that company.

NEWS NOTES

FINANCIAL.

DORRIS, CAL.—Dorris has voted a $12,500 bond issue for a municipal water system.

VALLEJO, CAL.—The board has approved of the plan, profile and specifications for the laying of the new 14-inch water main from Fleming Hill to this city and the 8-inch main from Géorgia street to Fourth street, South Vallejo; also the plan and specifications for the new municipal wharf to be built at the foot of Lemon street in South Vallejo.

INCORPORATIONS.

WILLOWS, CAL.—The Peoples Power Company has been incorporated by C. R. Wickes, D. A. Shellooe, W. H. Travis, W. E. Scearce, J. T. Green, A. H. Quatman and others, with a capital stock of $180,000.

VISALIA, CAL.—The Alpaugh Telephone & Telegraph Company has been incorporated by N. L. Wilson, T. G. Adams, C. E. Timmons, W. F. McFarland and M. G. McNeely, with a capital stock of $25,000.

ALBERNI, B. C.—The Alberni District Electric Light & Power Company, Ltd., has been incorporated by Dr. A. D. Morgan, W. G. McAllister, of this place. The new company will install fixtures and supply electric lights in all houses in this city.

TRANSMISSION.

NORTH YAKIMA, WASH.—This place will in all probability install a municipal lighting plant.

SILVERTON, ORE.—R. K. Page, of Salem, superintendent of the Portland Railway, Light & Power Company, is asking for a franchise in this city.

CALLAHAN, CAL.—The Scott River Dredging Company's plant here, was totally destroyed by fire last week. The loss is estimated to be $75,000.

WASHOUGAL, WASH.—The Mt. Hood Railway, Light & Power Company, Commercial block, Portland, has secured a franchise from the City Council to furnish power and light to the city.

TACOMA, WASH.—The Nisqually Power Company has granted a contract for the steel bridge and pressure pipe work on the substation in this city, to Hans Pederson of Seattle, Wash.

TACOMA, WASH.—The municipal commission has finally awarded a contract for completing the municipal hydroelectric plant on Nisqually River at La Grande to Hans Pederson, Madison building, Seattle, at $1,074,918.

FOREST GROVE, ORE.—The City Council has granted a franchise for 25 years to the Independent Electric Company for the transmission of current and the erection of poles over certain streets of this city.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company will expend $52,000 in the spring in the erection of a power and concentrating plant at Trestle Creek, eight miles from this place.

HUSUM, WASH.—The Husum Power Company will shortly commence the erection of a concrete dam across the White Salmon River near the present intake to the power plant. An increase of 1000 h.p. will be available at the dam. It is probable that the main power plant will be enlarged extensively.

OROVILLE, CAL.—That another large power plant is to be located in Butte County was learned when a trust deed conveying 90,000 miner's inches of water on the Middle Fork of the Feather River was filed. The deed conveys the water to George H. Tully, H. B. Lind and M. P. Barnes, all of Sacramento. The rights were sold by M. E. and H. O. Lague, of Sparks, Nev. The rights are to be held in trust until such time as the Central California Hydroelectric Power Company is organized and financed to develop the water rights.

KOOSKIA, IDAHO.—It is reported that work will start in June on the construction of a huge dam at this point by eastern capitalists. The dam will be built across the middle fork of the Clearwater river and will cost $200,000; 5000 h.p. will be developed. The survey for the project was made by Engineer T. H. Croswell of Spokane and W. J. Bell of Newaygo, Mich., who drew up all specifications for prospective bidders. With the completion of the dam a pulp mill, sawmill and other industries will be established.

ILLUMINATION.

MARTINEZ, CAL.—The Great Western Power Company has been granted an electric lighting franchise in this city.

ELSINORE, CAL.—The City Council has passed an ordinance granting to M. A. Gardner and M. L. Cambern a franchise to construct and operate a gas plant here.

PORTLAND, ORE.—Bids will be received at the office of R. H. Thomas, Portland, until 5 p. m. March 23, for material to be used in the installation of electrical equipment in the school buildings.

LOS ANGELES, CAL.—A three-story brick building 100x100 feet at the corner of Fourth and San Pedro streets, has been leased for ten years by the Phoenix Lighting Fixture Company, and work of installing a manufacturing plant there will begin at once. It is expected to have the plant in full operation by April 1st.

ANAHEIM, CAL.—The sale of the controlling interest in the Orange gas plant has been announced by Manager Miller of the Orange County Gas Company, whose offices are in Anaheim. A Los Angeles corporation, it is claimed, is the purchaser. It is said that this new firm will renovate the plant, re-pipe the town and build a gas holder.

STOCKTON, CAL.—The Western States Gas and Electric Company announces that within 60 days Stockton will have a $1 gas rate. The rate for manufactured gas has been $1.50 per 1000 cubic feet. The rate for natural gas is $1 per 1000 cubic feet, with a 5 per cent discount on bills paid on or before the 10th of each month.

SAN BERNARDINO, CAL.—Bids for the lighting of the city's streets were not opened according to schedule at last week's council meeting. Instead bids were ordered held unopened for two weeks during which time an investigation is to be made of a certain proposition from the Lytle Creek Power Company, leading to the purchase of its system for a municipal plant.

FRESNO, CAL.—The recent removal of the headquarters of the San Joaquin Light and Power Company from Fresno to Los Angeles will not effect the general offices here, according to A. G. Wishon, manager of the company. He said: "The corporation was reorganized at Los Angeles because most of the stockholders are Los Angeles people, and it is inconvenient for them to come to Fresno for meetings."

TRANSPORTATION.

LOS ANGELES, CAL.—Dr. W. F. McBurney has petitioned for a franchise for a cross-town car line on Vermont avenue from Fourth to Vernon avenue.

FRUITVALE, CAL.—Plans are being made by the Oakland Traction Company to build a new electric car line on Redwood road, extending from the foothills to East Fourteenth street.

SALT LAKE, Utah.—Within ten days the Payson Electric Railroad Company, which is about to build an interurban electric line between Salt Lake and Payson, Utah county, will ask for franchises.

LONG BEACH, CAL.—H. C. Arnold has been granted a franchise for a scenic railway on Pike street, this city. The construction work will commence by April 1st and when completed, the road is expected to cost $85,000.

OAKLAND, CAL.—The Oakland Traction Company has applied for 35-year franchises on Clay street from San Pablo avenue to Eighth street; Market street from San Pablo avenue to Fifty-fifth street; Thirteenth street from Washington street to Market street and on Market street from Thirteenth to Fourteenth streets.

MODESTO, CAL.—The Modesto Board of Trustees has sold to the San Joaquin Valley Electric Railway Company a franchise for an electric road through the city. The franchise is for a right to lay tracks on Elm street and Eighth street. This is the first of two electric railways which will enter Modesto in the near future. The Tidewater and Southern Railway Company has applied for a franchise to operate a line from Merced.

TELEPHONE AND TELEGRAPH.

CHICO, CAL.—John Leaper announces that the Home Telephone Company is about to install its system in this city.

FRESNO, CAL.—The Vineland Telephone Company of Kerman, with J. C. Ashlin as president and R. S. Elliott as secretary, has been granted permission to erect telephone lines along the public streets and highways in this city.

MARTINEZ, CAL.—At a recent election the following were elected officers of the Pacific Telephone & Telegraph Company: Henry T. Scott, president of the Pacific Company; E. C. Bradley, first vice-president and general manager; E. J. Zimmer, second vice-president; Louis Glass, third vice-president, and F. W. Eaton, secretary and treasurer.

WATERWORKS.

SILVERTON, ORE.—The city of Silverton is calling for bids for the construction of a water and sewer system.

MADERA, CAL.—The City Trustees have let the contract for installing a complete water system to F. C. Roberts Co., Inc., of San Francisco.

TACOMA, WASH.—The Council has passed an ordinance providing for the construction of a six inch cast iron water main to be constructed in the city of Tacoma on Madison street, Gunnison street, Monroe street, and Tyler street.

LOS ANGELES, CAL.—Patton & Longley Company are placing on the market a tract of 800 acres in San Fernando Valley, and state that they are to install a complete free water system, including pumps, pipe and ditches at a cost of $15,000.

GRESHAM, ORE.—A serious mistake, made while testing the new pipe line near the Lusted school house, will prove costly and delay the completion of the line. It is estimated that the cost of replacing the ruined section will be about $5000, as new pipe will have to be secured.

SAN FRANCISCO, CAL.—The Spring Valley Water Company has completed a three-foot raise in the Crystal Springs dam. The extra storage capacity of that body of water, nine miles long, with an average width of three-quarters of a mile, has been increased by 1180 million gallons.

JACKSON, CAL.—H. F. C. Fusier has filed on 100,000 inches of water on Amador county creeks as follows: Ashland Creek, 30,000; south branch Sutter Creek, 25,000; Golden Gate branch of Sutter Creek, 20,000; Pioneer branch of Sutter Creek, 25,000. The filings are for the volcano reservoir project.

PENDLETON, ORE.—At a meeting of the Board of Water Commissioners it has been decided to submit the question of bonding the city in the sum of $200,000 for a gravity water system, and as planned to include the construction of two reservoirs, one on the hills on either side of the river which run through Pendleton.

ONTARIO, CAL.—The City Council has received 14 bids for furnishing and laying pipe for the $175,000 municipal water system. Contracts were awarded to the Western Pipe Company at $16,397.90 for steel riveted pipe; Crane & Co., at $79,375.39 for screw pipe and specials and Joe Chutuk, Los Angeles, at $18,881.87 for laying pipes. Total cost, $105,685.21.

REDMOND, ORE.—At a meeting of the City Council to estimate cost of the proposed water system that Warren & Woodard, civil engineers of this city, had been asked to prepare, was submitted. The length of the pipe line from the reservoir to the city limits is two miles, and 10-in wooden pipe is proposed as the supply main for that distance, at a cost of $19,000.

ALAMEDA, CAL.—C. E. Gilman of the Union Water Company, the successor of the Bay Cities Water Company announced to Mayor Noy last week that the company would commence laying mains for the new Mt. Hamilton water supply within a few weeks. The 4 inch pipe for the domestic supply is all on hand, but the work of main laying will be held off until the 6, 8 and 12 inch crosstown mains arrive.

SAN FRANCISCO, CAL.—The first of the $45,000,000 Hetch Hetchy bond issue has been advertised by the Supervisors, bids for that amount to be received April 20th. The 60-day period is allowed to permit all parties ample time to make up their offers. The Supervisors despite the fact that the same amount was offered some weeks ago and after 30 days' notice received no bids, are confident that the securities will be sold this time.

SAN FRANCISCO, CAL.—The question of whether the Spring Valley Water Company is to be allowed to continue refusing to expend money for necessary extensions of its service on the plea that it is threatened with the city's competition is to be tested in the courts. This is the determination arrived at by the water rates committee of the Supervisors after a lengthy and at times warm discussion, in which Attorney E. J. McCutchen, for the company, flatly announced that the policy of the corporation on the point mentioned would be as stated.

JACKSON, CAL.—Edward Reckords of San Francisco has filed on 110,000 inches of water in the streams of Amador county. The filings comprise 25,000 inches in Panther creek, 25,000 inches in Mill creek, 25,000 inches in Tiger creek, 25,000 inches in East Panther creek and 10,000 inches in Antelope creek. Reckords also claims the natural flow, freshet and sewage waters running in those streams. The purposes stated in the filing are for irrigation, domestic, municipal and agricultural uses and for the generation of electric power in Amador, Sacramento, Calaveras and San Joaquin counties and as much further as practicable.

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A HEAVY BLAST IN DAM CONSTRUCTION

An interesting example of the use of heavy blasts in the construction of a high, rock-fill, storage reservoir dam is exemplified in the Cucharas Dam, Huerfano County, Colorado. This dam is being built by the Pueblo-Rocky Ford Irrigation Company. It will be of the rock-fill type with a concrete face and spillway. It will have an elevation to the spillway crest of 125 ft. and a length of 534.3 ft. There will be required in its construction approximately 210,000 cu. yds. of broken rock and 6000 cu. yds. of concrete.

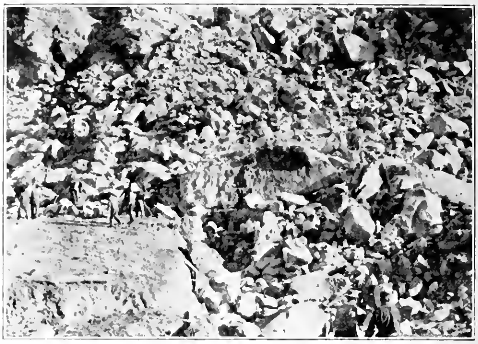
The site of the dam is a box canyon, between walls of limestone, sandstone and shale, the strata being more or less horizontal. In anticipation of floods, which might be encountered before completion of the embankment to the spillway line, construction is designed with a view of passing the flood-water over the embankment. For this reason, rocks of the largest possible size are required, especially for construction of the down stream toe and for surfacing the downstream slope.

Site of the Cucharas Dam of the Pueblo Rocky Ford Irrigation Company.

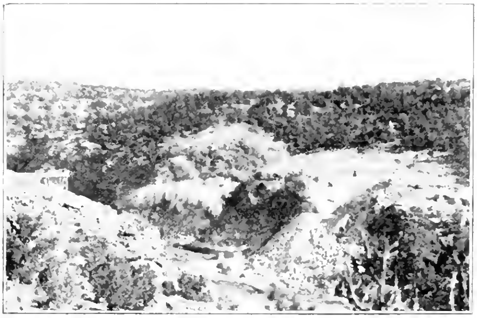
In order to obtain rock of the desired character, it was proposed to place a heavy blast in the wall of the canyon adjacent to the downstream toe of the dam and bring down a large quantity of rock to the base of the dam.

A "coyote-hole," or "one-man" tunnel was driven into the east wall of the canyon and above a bed-rock trench along the downstream toe of the embank-

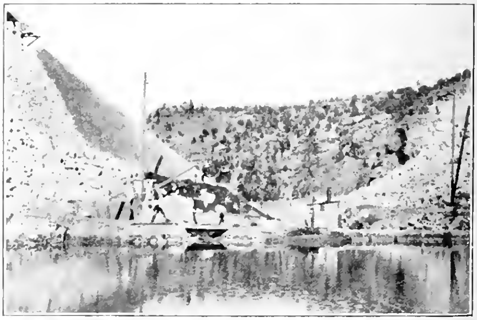
Site Showing Coyote Hole in Which Charge Was Placed.



Result of the Break.



Firing the Charge.



Site Ten Weeks Later.

ment. The "coyote-hole" is shown at the top of the left-hand dump; it was driven a distance of 40 ft. into the cliff, at which point a cross-cut or "T" was excavated, a distance of 24 ft. between headings. At each heading of the cross-cut a shaft 4 ft. x 4 ft. x 4 ft. was sunk below the tunnel floor.

Each of the pits was charged with 7500 lb. of F. F. B. powder and 500 lb. of 40 per cent dynamite, connected with electric fuses and leading wire which was carried to a firing battery located about 300 ft. distant. The cross-cuts and tunnel were then back-filled with earth, which was thoroughly tamped.

Firing of the charge is shown in the second view of the group and in it may be plainly seen the path of rocks. Some of these rocks weighed from 2000 to 3000 lb. and were sent, at high velocity, across the canyon, a distance of 250 ft.

A view of the break and an idea of the size of rocks placed in the downstream toe-trench is next in order.

Some idea of the amount of work which was done on this dam in ten weeks is given in the last picture; as it was taken about that length of time after the general view first shown.

The cost of driving the tunnel, of explosives and of setting and firing the charge, was as follows:

Labor	$ 384.00
Powder	1140.00
Dynamite	155.00
Caps and fuse	10.50
	$1689.50

The cost of breaking 10,000 cu. yds. of rock was therefore 16-89/100 cents per cu. yd.

This work is being done under contract by the Phillips Construction Company & O'Gara of Denver, Wm. M. Strong being engineer in charge.

GOVERNMENT SUIT AGAINST LAMP MANUFACTURERS.

The Attorney General of the United States on March 3rd instituted suit against 35 incandescent lamp companies, including the members of the National Electric Lamp Association, the General Electric Co., and the Westinghouse Lamp Co., on the charge of engaging in unlawful contracts, combinations and conspiracies in restraint of interstate commerce. On the basis of patents owned by these companies it is stated that they have monopolized the manufacture of incandescent lamps and suppressed competition. It is believed that the combination will be voluntarily dissolved without litigation.

PACIFIC COAST PRACTICE AS REGARDS THE USE OF CRUDE PETROLEUM AS FUEL.

The December, 1910, meeting of the American Society of Mechanical Engineers was devoted to a discussion of Pacific Coast practice as regards the use of crude petroleum as fuel. The papers presented are published in full in the following pages:

PRESENT AND FUTURE SUPPLY OF PETROLEUM AS FUEL ON THE PACIFIC COAST.

BY ARTHUR F. L. BELL.

In the study of our petroleum deposits we have to deal with the leading mineral industry of California. Its exploitation commencing in the early sixties, with a recorded production in 1875 of only 3000 barrels, has been increased to 75,000,000 barrels for the year 1910. Attention was first drawn to the presence of petroleum in California by the discovery of numerous oil seepages in Los Angeles, Ventura, Santa Barbara and adjacent counties. A large portion of these counties are mountainous, the formation is broken and tilted, with a result that oil in many places can be seen seeping from the rocks. Even in the Pacific Ocean, from Port Harford to San Pedro, there are numerous oil springs where petroleum rises to the surface and spreads out, giving the ocean a glazed surface many miles in area.

The first oil producers in California knew practically nothing of the geology of the oil or of the districts where they operated. They looked for a location where oil bearing rocks were exposed with oil seeping from them. They then determined, to the best of their judgment, the angle or dip of the strata and located their wells so as to reach the oil at a shallow depth. Many of the wells were failures, partly due to misjudgment of the depth of the strata, or, to the formation having been already drained of its oils. The uncertainty and expense of drilling deeper wells often prevented an extension of proven territory. As late as 1900 a well 2000 feet in depth was considered exceptionally deep and there were but a few in the State, whereas, today, we have wells of a mile or over in depth.

Most of the early drilling was confined to Ventura county and until the discovery of the Los Angeles City field, no other area exceeded 40 acres. In 1892 the Los Angeles field came in with an approximate area of 4000 acres. The oil territory traversed a narnow strip in the northwestern portion of the city, crossing hundreds of city lots, with the result that all lot owners became oil operators, or leased their lots to others. The formation was so easily drilled that portable rigs were used and, in many instances, 8000 foot wells were completed in a week. Such conditions resulted in an immediate over-production with a corresponding drop in price, from about $1.50 per barrel, previous to the discovery of the Los Angeles field, to from 15 to 30 cents per barrel in Los Angeles in 1896. This low price resulted in the adoption of oil by every Southern California industry that required fuel. The real opening of California's oil industry may be said to have dated from the discovery of the Los Angeles field. In 1898 this field was on the wane and the price of oil rose to one dollar. The development of this field and the universal adoption of oil in Southern California had educated and interested so many men in the oil industry, that as it showed signs of exhaustion, they branched out, seeking new fields, with the result that the Fullerton, Coalinga, Kern River, McKittrick and Sunset fields were immediately exploited, in the order named. By 1902 so much oil had been developed that the price again fell to 15 or 20 cents per barrel in the Kern field. The production of the cheap Kern River oil forced its use over the Pacific Coast States as well as the Hawaiian Islands.

In giving a brief history of the development of the oil industry, it is my endeavor to show that in the first stages of the business, the discovery and development of oil was largely a matter of chance. All of the early fields were discovered by drilling close to oil seepages, including the Los Angeles city field, Kern River, Coalinga and Sunset. The Summerland field was discovered by chance through digging a water well. The Kern River was discovered by a wood chopper who, having seen a small seepage on the bank of Kern River, dug a well and with the proverbial good luck of the novice, struck oil at about 75 feet. Today the industry has become so well understood that, to extend the field, instead of the operator hugging the outcrop, he confidently locates his well far out into the valley, or in the outlying ranges within the possible oil belt, in many cases miles from the nearest production. Where he has used fair judgment based on the knowledge which we now have of the geological conditions of the oil measures, the chance of failure has been greatly reduced, as is shown by the recent and important discoveries of oil and gas in the Lost Hills, Kettleman Hills, Buena Vista Hills and Elk Hills, in Kings and Kern Counties. These discoveries made during the last year have proved the existence of oil over large areas where heretofore it was a matter of conjecture.

The present development of the oil industry is due, first, to the great improvements which have been made during the last ten years in the art of drilling wells, which has enabled us to reach successfully and economically depths of from 4000 to 5000 feet, and second, to the knowledge we have acquired of the oil bearing formation. For the latter, we are to a great extent indebted to the splendid work of the United States Geological Survey, which has for the last few years had a corps of geologists in the field, mapping and cross-sectioning proven and possible oil territory. This has resulted in our being able to trace the oil bearing strata under large areas of yet unproven territory; and it is satisfactory to note that during the last year, successful discoveries have been made in far outlying districts which have been reported as possible oil territory by the Survey.

The California oil fields are found in rocks of the tertiary, whereas the Eastern fields, with one or two exceptions, are found in earlier geological formations. California oils are found mostly in loose sandy beds; in many cases these sand strata are from 400 to 500 feet thick, which allow enormous storage of oil. In Eastern fields the older rocks have become so cemented and are so close grained that there is no room for storing oil, this accounts for the small production per acre of Eastern wells compared with those of California.

In 1908, the United States Geological Survey reported 8450 square miles of possible oil territory in the United States, giving California 850 square miles or about one-tenth of the total area; but they give her credit for one-half of the probable minimum oil production of the United States, or one-third of the probable maximum production.

The United States Geological Survey has estimated the contents of the probable oil lands of the United States in barrels of 42 gallons as follows:

	Minimum.	Maximum.
Appalachian field	2,000,000,000	5,000,000,000
Lima-Indiana field	1,000,000,000	3,000,000,000
Illinois field	350,000,000	1,000,000,000
Mid-continent field	400,000,000	1,000,000,000
Gulf field	250,000,000	1,000,000,000
California field	5,000,000,000	8,500,000,000
Minor fields	1,000,000,000	5,000,000,000
Total	10,000,000,000	24,500,000,000

California's greater productiveness is due to the greater thickness of loose oil sands. The 1907 Survey report of average daily production of wells in the different fields of the United States shows that California wells pump three times as much as those in the Gulf fields and five to eight times as much as the other active Eastern fields.

Appalachian field	1.73 barrels
Lima-Indiana field	2.74 barrels
Colorado and Wyoming field	8.35 barrels
Illinois field	8.37 barrels
Mid-continent field	5.29 barrels
Gulf field	14.08 barrels
California field	42.56 barrels

The estimated production given by the United States Geological Survey were conservative estimates when made two years ago. Development in the industry has however been so rapid, that the estimates of proven and possible territory made then, will not answer for today. I have therefore compiled an estimate of what I consider the proven and prospective areas in California today, which shows a total area of practically proven oil territory of 94,200 acres, with an estimated production of 4,319,000,000 barrels and a probable extension of oil territory of 338,320 acres with an estimated production of 13,258,000,000 barrels, making a grand total of proven and probable territory of 432,520 acres and 17,577,000,000 barrels. The total consumption to date has been about 383,000,000 barrels, leaving an estimated future possible production of 17,194,000,000 barrels.

The accompaning table gives an itemized statement of production by districts and counties:

In submitting the above estimate of extractable oil, which is about double the United States Geological Survey estimate, I can only say that it is impossible for any one to state definitely what our actual production will be. I have included as possible territory only what I consider probable territory, amounting to about 700 square miles; but it is quite possible that a greater acreage will be developed which will bring the total up to or over the estimate of the United States Geological Survey of 850 square miles. This should again increase the quantity of prospective extractable oil.

In my computation I have assumed the interstices in the sand to be 3/10 of its bulk, and that it is filled with oil of which 1/10 would be held by capillary attraction to the sand, 1/10 as readily extractable oil and the remaining 1/10 as oil which cannot be obtained. This would admit a production of about ¾ gal. per cubic foot. To substantiate these figures, I will state that prior to 1900, the Alcatraz Asphalt Co.,

CALIFORNIA'S ESTIMATED FUTURE OIL SUPPLY.

County and District	Proven Acreage	Thickness of sand (feet)	Estimated Production (barrels)	Possible Acreage	Thickness of sand (feet)	Estimated Production (barrels)	District Grand Total Acreage	District Grand Total Production (barrels)	County Grand Total Acreage	County Grand Total Production (barrels)
Fresno—										
Coalinga	29,000	50	1,128,000,000	21,440	50	834,000,000	50,440	1,962,000,000		
Kettleman Hills				20,080	50	778,000,000	20,080	778,000,000		
Kreyenhagen Hills										
County total	29,000		1,128,000,000	41,520		1,612,000,000			70,520	2,740,000,000
Kings—										
Kettleman Hills				53,120	50	2,064,000,000	53,120	2,064,000,060		
County total				53,120		2,064,000,000			53,120	2,064,000,000
Kern—										
Lost Hills				46,080	50	1,800,000,000	46,080	1,800,000,000		
Devil's Den				14,720	50	596,000,000	14,720	596,000,000		
Antelope Hills				16,000	50	622,000,000	16,000	622,000,000		
McKittrick	2,000	50	85,000,000	6,400	50	250,000,000	8,800	380,000,000		
	400	150	45,000,000							
Midway-Sunset	10,000	50	1,700,000,000	100,480	50	4,000,000,000	140,480	5,700,000,000		
San Emidio				12,000	50	466,000,000	12,000	466,000,000		
Kern River	6,000	150	590,000,000				6,000	590,000,000		
County total	18,400		2,420,000,000	195,680		7,734,000,000			244,080	10,154,000,000
Santa Barbara—										
Santa Maria	3,600	25	70,000,000				3,600	70,000,000		
Lompoc	1,280	25	25,000,000	2,000	50	26,000,000	3,280	51,000,000		
Cat Canyon	1,920	50	76,000,000	16,000	50	622,000,000	17,920	698,000,000		
County total	6,800		171,000,000	18,000		648,000,000			24,800	819,000,000
Southern California fields—										
Fullerton	5,000	100	100,000,000	5,000	50	200,000,000	10,000	600,000,000		
Whittier										
Olinda, etc.										
Miscellaneous	5,000	50	200,000,000	25,000	50	1,000,000,000	30,000	1,200,000,000		
Southern Cal. total	10,000		600,000,000	30,000		1,200,000,000			40,000	1,800,000,00
Total: Proven acreage	94,200									
Total: Possible acreage				338,320						
Estd production: Proven acreage			4,319,000,000							
Estd production: Possible acreage						13,258,000,000				
Final grand totals							432,520	17,577,000,000	432,520	17,577,000,00
Less oil produced to 1911								383,000,000		383,000,00
California's estimated future supply								17,194,000,000		17,194,000,00

in Santa Barbara County, of which I was manager, mechanically extracted from the bituminous sands at its Carpenteria and Sisquoc refineries, 27 per cent and 25 per cent respectively, of bitumen. These were exposed oil sands from which the bitumen or dried out oil was being extracted.

In 1901 Bernard Bienenfeld, William Mulholland, and the writer, as commissioners for the purpose of appraising the value of the different properties in the Kern field that were to form the Associated Oil Company, determined that the Kern field oil sand did contain 32 per cent of void in the sand and when filled with oil, amounted to 2.4 gallons per cubic foot.

It will therefore be seen that an estimate based on an extraction of ¾ gallons per cubic foot, or 750 barrels per acre foot, should not be considered as unreasonable if the correct thickness of producing sands is figured. I quote from a paper on the oil industry read before the mining students of the University of California by Mr. M. L. Requa: "A few of the practical results from California fields that are obtainable at this date as follows:

Sauer Dough in Coalinga: Claimed thickness of sand 60 ft. Production per acre 96,000 barrels, or about 1600 barrels per acre foot.

Claremont in Kern River: Claimed thickness of sand 250 feet. Production per acre 93,000 barrels or about 330 barrels per acre foot.

Peerless in Kern River: Claimed thickness of sand 300 feet. Production per acre 84,000 barrels or about 280 barrels per acre foot.

Santa Fe in Fullerton: Thickness of sand over 700 feet. Production per acre 93,000 barrels or about 132 barrels per acre foot.

Los Angeles: Thickness of sand 100 feet. Production 75,000 barrels per acre or about 750 barrels per acre foot.

It is worthy of note that all of these properties are still active producers.

The following is a list of the recorded production of California from 1875 to 1910, inclusive, and the average daily production per well:

	Total barrels produced.	Average bbl. per well per day.
1875	3,000	4.11
1876	12,000	16.39
1877	13,000	11.87
1878	15,227	13.91
1879	19,858	13.75
1880	40,552	15.83
1881	99,862	27.35
1882	128,636	27.11
1883	142,857	24.46
1884	262,000	35.74
1885	325,000	38.70
1886	377,145	39.74
1887	678,572	50.24
1888	690,333	39.30
1889	303,220	16.28
1890	307,360	15.88
1891	323,600	11,98
1892	385,049	9.50
1893	470,179	8.26
1894	705,969	10.12
1895	1,208,482	13.19
1896	1,252,777	8.78
1897	1,903,411	9.57
1898	2,257,207	8.30
1899	2,642,095	7.66
1900	4,324,484	9.15
1901	8,786,330	11.19
1902	13,984,268	15.99
1903	24,382,472	25.94
1904	29,649,434	29.84
1905	33,427,473	33.49
1906	33,098,598	34.07
1907	39,748,375	42.56
1908	48,306,910	41.00
1909	57,545,477	43.10
1910 (estimated)	75,000,000	42.10
Total	382,821,212	

To determine the life of our field, taking the submitted figures as a basis, we would have if we assumed the present production of 75,000,000 barrels as the maximum consumption, 52½ years supply for the proven territory and for the proven and prospective territory, less consumption to date, about 230 years supply. If our consumption is increased, as it naturally will be, the life of our fields must be reduced proportionally.

Our consumption for 1910 will amount to about 63,000,000 barrels, as about 12,000,000 barrels will have gone into storage this year. At the end of 1910, we will have in storage about 30,000,000 barrels or about five months' supply.

RELATIVE VALUE OF LIGHT OIL AS COMPARED WITH HEAVY OIL.

BY J. N. LE CONTE.

The object of the following note is to show the approximate relation that holds between the heating value and specific gravity of California crude petroleum.

Crude petroleum consists principally of various combinations of hydrogen and carbon together with comparatively small amounts of nitrogen, oyxgen and sulphur. The nitrogen and oxygen and any incombustible residue or ash may be classed as inert impurities. The sulphur, though combustible, has a low grade of heating value and is otherwise injurious.

Taking hydrogen and carbon as the principal constituents, it is found that those oils which are rich in the former element are of light specific gravity as compared with those rich in carbon. The range in specific gravity of California oils may be taken as from unity to 0.84, or from 10 to 36 of the Baume scale. The majority of the fuel oils will range from unity to 0.9, or from 10 to 23 Baume.

In regard to the heating value, it is also evident that, other things being equal, those oils rich in hydrogen will contain more heat units per pound than those rich in carbon. Pure hydrogen contains 62,000 B.t.u. per pound, as compared with 14,500 B.t.u. per pound for carbon. If the substance in question, therefore, were composed wholly of these two elements, a consistent law might be expressed between the heat units per pound, and the specific gravity. As a matter of fact the other substances occurring in varying amounts destroy any exact relation.

Water in emulsion in crude oil, not only acts as an inert impurity in a sample under test, but must be converted into steam in the furnace and this still further reduces the heat value of the fuel per pound. It occurs in such variable, and often in such large amounts, that no relation whatever between specific gravity and B.t.u. per pound can be discerned unless its presence is eliminated. In the following tables and diagrams, therefore, the oil is anhydrous, the water having either been removed before testing, or else its amount has been determined and corrected for.

Nitrogen and oxygen are also inert impurities, but since their amounts are small, their effects are averaged in the plotted results.

Sulphur is a substance which causes considerable variation in the heating value of fuel oil. Sulphur contains 3900 B.t.u. per pound. Oils rich in sulphur,

therefore, have a lower heating value per pound, other things being equal.

Many determinations of heating values and specific gravities of California oils have been made, but those upon which the following table is based have been furnished through the kindness of Professor Edmond O'Neill and his assistants and were made in the chamical laboratories of the University of California.

The calorific values were determined by means of an Atwater bomb calorimeter, and the specific gravity by means of a Westphal balance or a pycnometer flask at about 63 degrees F. Water was determined by distillation.

The resulting values for the heavier fuel oils the writer has collected and plotted as shown in Fig. 1.

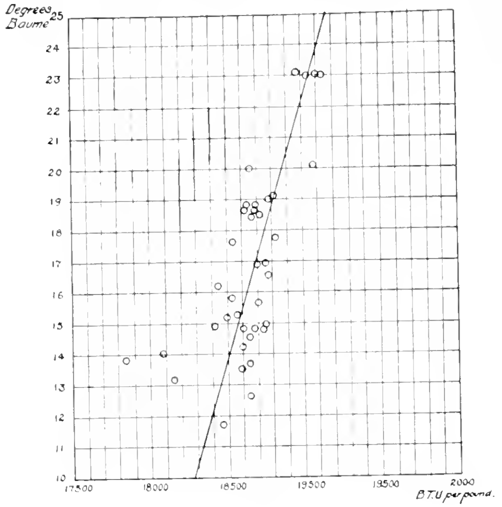


Fig. 1.

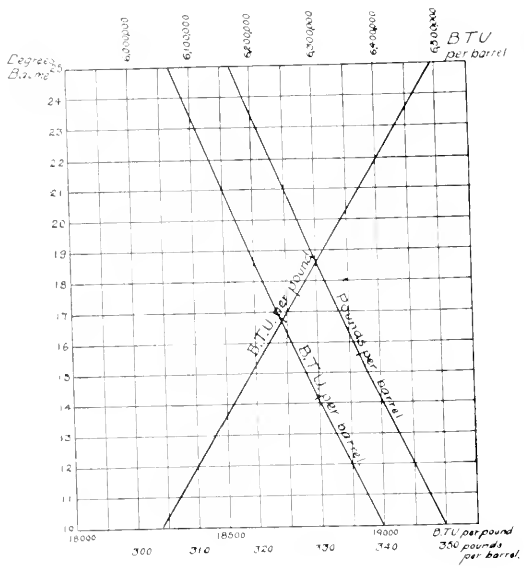


Fig. 2.

The ordinates in this case are degrees of the Baume scale, which is related to the true specific gravity by

$$\text{the relation Sp. Gr.} = \frac{140}{130 + B} \text{ or } B = \frac{140 - 130}{\text{Sp. gr.}}$$

at 63 deg. F. The abscissae are British thermal units per pound of the anhydrous oil. The points, as might be expected, are rather scattered, but can be approximated roughly by a straight line. In drawing the average line through these points the writer has been guided for its position wholly by the points themselves, and for its inclination by the points, and by the table of average specific gravities and calorific values furnished by Mr. R. W. Fenn of the Union Oil Company, whose table covers a wider range of specific gravities than do the determinations gathered by the writer. The average line gives the relative B.t.u. per pound $= 17680 \times 60$ B over the range of these measurements.

Table I gives the computed values of B.t.u. per pound, and specific gravity, as well as the weight per barrel, and B.t.u. per barrel, as determined from this average line. Fig. 2 shows the same quantities graphically expressed.

TABLE I.

Degrees Baume.	Specific Gravity.	Weight per barrel.	B.T.U. per pound.	B.T.U. per barrel.	Degrees Baume.
10	1.0000	350.035	18280	6,398,600	10
11	.9989	347.55	18340	6,374,100	11
12	.9859	345.10	18400	6,349,800	12
13	.9790	342.68	18460	6,325,900	13
14	.9722	340.30	18520	6,302,400	14
15	,9655	337.96	18580	6,279,300	15
16	.9589	335.65	18640	6,256,500	16
17	.9524	333.37	18700	6,234,000	17
18	.9459	331.10	18760	6,211,400	18
19	.9396	328.89	18820	6,189,700	19
20	.9333	326.69	18880	6,167,900	20
21	.9272	324.55	18940	6,147,000	21
22	.9211	322.42	19000	6,126,000	22
23	.9150	320.28	19060	6,104,500	23
24	.9091	318.22	19120	6,084,400	24
25	.9032	316.15	19180	6,063,800	25

From these it is seen that although the average heating value per pound of crude oil increases as the specific gravity diminishes, it does not increase so rapidly as the weight per unit of volume diminishes. The heating value per barrel of the heavier oils is therefore greater than that of the light ones.

COMPARATIVE EVAPORATIVE VALUES OF COAL AND OIL.

BY C. F. WIELAND.

While there is undoubtedly a large amount of available information relating to evaporative performance of steam generating plants using coal and oil as fuel, it is usually only valuable in so far as it allows of comparison of different boiler units. It serves chiefly to show the degree of excellence of construction, furnace arrangement, etc., rather than the evaporative value of the fuel itself. Similarly we could hardly expect to judge the value of super-heated steam as a factor of economy from tests made on two engines of widely different designs even though the tests showed high results. On the subject of evaporative values of the fuels in question, there seems to be a dearth of available data.

Coal: It is only in recent years that exhaustive experiments have been made in this country and abroad

to determine the evaporative efficiency of the different coals. The most important of these is the work of the U. S. Geological Survey at its testing plant in St. Louis, now being continued in Pittsburg, which is destined to contribute largely to our knowledge on fuel combustion. Until recently we were accustomed to judge coal almost entirely by its number of B.t.u. and its per cent of ash after correction for moisture. It is on this basis that coal is bought by the U. S. Treasury Department. Moisture, however, being an unstable quantity, can hardly be taken into account except at the moment of firing.

A proximate analysis is usually all that is examined. Such analysis, although giving the percentage of volatile and combustible matter, is hardly in itself sufficient to show its true evaporative value.

Although the volatile content of coals was always known to be the source of greatest heat loss, the nature of these losses and how influenced by the per cent of volatile matter contained, has been but recently investigated by the U. S. Geological Survey and by Constam & Schlapfer in Switzerland. The remarkable coincidence of the results of these tests leaves little room for doubt as to the correctness of the conclusion. Primarily, this is that coals of the same calorific value decrease in evaporative efficiency as their content of volatile matter increases. Constam & Schlapfer show for European coals that the maximum efficiency is obtained from coals having a volatile content of from 16 to 23 per cent of combustible matter. The losses due to the volatile content lie principally in incomplete combustion of the higher hydro-carbons whose action during combustion seems not to be clearly understood. It is assumed that they either pass out of the furnace unconsumed, or, at higher temperature are decomposed into their elements, and under an insufficient air supply or too low an air temperature the liberated carbon passes out of the stack unconsumed as soot.

The combustion of coal may be briefly considered to take place as follows: Under an excess air supply volatile matter is rapidly distilled from the coal at comparatively low temperatures. If the air temperature is not sufficiently high or its volume inadequate the gases pass off unconsumed, in fact do not become ignited. Ordinarily they are ignited, but if the furnace construction is such that they cannot be entirely consumed before striking the cool heating surfaces of the boiler they are again extinguished and the greater part of their heat value dissipated.

The volatile matter having passed off, the remaining C burns to CO_2 with a certain percentage incompletely burned to C O.

The principal loss in our bituminous coals being due to volatile matter, it becomes necessary to observe certain fundamental principles, to efficiently reduce this loss.

(a) The gases must be distilled from the coal slowly and uniformly.

(b) They must then be thoroughly mixed with air of high temperature.

(c) They must be given sufficient space in the combustion chamber to be fully consumed before coming in contact with the heating surfaces.

Mechanical stokers have already done much toward bringing about a slow and uniform evolution of the gases and in doing so have increased the evaporative efficiency appreciably. A further advance would possibly be a gauge in the up-take by which the amount of CO_2 contained in the flue gases could be periodically recorded.

Summarizing the foregoing, it is seen that the greater losses are due to the internal character of the fuel itself and that a special furnace arrangement with its attendant difficulties, based on the above fundamental principles may reduce these losses. Such arrangement will necessarily make the coal burning installation more cumbersome and costly.

Oil: Turning to oil fuel we readily see that the combustion of oil in the furnace is much simplified. With oil as a fuel the manual difficulties met in the hand firing of coal are practically eliminated.

The elements entering into skillful coal firing are not so necessary for oil firing. The reason lies in the nature of the fire itself. A more complete mingling of air and gas is possible. This also depends largely on the construction of the furnace but the elements entering into such construction lie nearer at hand than in coal burning furnaces.

Complete atomization of the oil at the burner tip by a jet of steam or air is of prime importance to combustion. The oil must be thoroughly vaporized before combustion can be complete. This is the function of the burner and is accomplished to a greater or less extent in a variety of burners on the market. It is evident that if the oil is not properly atomized it cannot be readily vaporized and that therefore not only a loss of heat ensues, but there follows an incrustation of the furnace.

Evaporation: In comparing the evaporative values of the two fuels, coal and oil, it is only fair to select a coal that is considered standard and that is largely used in evaporative tests. It would not be just to select a coal of inferior value such as are our western coals.

Therefore, as a basis of comparison, the writer selects Pocahontas coal and Kern crude oil whose analyses are as follows:

Proximate Analysis.	Pocahontas Coal. Per cent.	Kern Crude Oil 14.5 Gravity. Per cent.
Fixed carbon	73.30	
Volatile matter	17.61	
Moisture	.49	.15
Ash	8.60	
	100.00	
Ultimate Analysis.		
Carbon	82.26	87.64
Hydrogen	3.88	10.48
Sulphur	.49	1.02
Oxygen	4.12	.08
Nitrogen	.64	.78
Ash	8.60	
Sludge		none
	100.00	100.00

Calorific B.t.u., 14,067.
Coal data from Naval "Liquid Fuel" board report.

Assuming the complete combustion of the heat values in the two fuels as analyzed and knowing that 1 lb. of C requires 11.6 lb. air; 1 lb. of H. requires 34.8 lb. air; and 1 lb. of S. requires 4.3 lb. air, we have as

the volume of chemically required air for the combustion of the coal and the oil the following:

	Weight of air required. Coal.	Oil.
Carbon.		
Coal. 11.6 lb. air x .8226 lb. C...........	9.54	
Oil, 11.6 lb. air x .8760 lb. C...........		10.16
Hydrogen.		
Coal, 34.8 lb. air x .0389 lb. H..........	1.35	
Oil, 34.8 lb. air x .104 lb. H..........		3.62
Sulphur.		
Coal, 4.3 lb. air x .0049 lb. S............	.02	
Oil, 4.3 lb. air x .010 lb. S............		.04
Pounds of air required	10.91	13.82
Weight of combustibles (aftetr deducting ash from coal)	.91	1.00
Total weight, which we will consider as dry chimney gas	11.82	14.28

For our comparison we will make the following assumptions:

1. Flue gas temperature is the same in both cases, viz. 500 deg.
2. Moisture in the two fuels is the same.
3. Air intake temperature (temperature of fire room) 70 deg.

The flue temperature as placed at 500 deg. is probably the mean which obtains in practice; lower results have been obtained, but numerical value makes little difference in our comparison.

Moisture, as shown in the selected coal, is low and that in the selected oil is also low, in most oils it is more nearly an average of 5 per cent: for this reason we will consider that the moisture content is the same in each case.

The sensible heat carried away in the flue gases in the case of the coal is:

$$.24\ (500\text{-}70) \times 11.82 = 1219.8 \text{ B.t.u.}$$

In the oil $.24\ (500\text{-}70) \times 14.82 = 1529.4$ B.t.u.

.24 being the specific heat of the chimney gases.

In the combustion of hydrogen to water each lb. of H. results in 9 lb. of water, or in our coal the water formed will be $.038 \times 9 = .34$ lb.

The heat loss both latent and sensible in the evaporation of this water is: $.34\ (142 + 966 + 288 \times .47) = 422.6$ B.t.u., wherein 212 deg.—70 deg. = 142 assuming the temperature of the water in the coal to be that of the fire-room and 966 being the latent heat of the formation of steam at 212 deg. and of expansion against the atmosphere, and 500 deg. — 212 deg. = 288 being difference between steam at 212. deg. and the flue temperature as assumed; and .47 being the specific heat of superheated steam at atmospheric pressure (as in paper "Thermal Properties of Superheated Steam," in Vol. 30 of Trans. A. S. M. E.)

In case of oil we have: $.104 \times 9 = .936$ lb.

Heat loss is: $.936\ (63 + 966 + 288 \times .47) = 1088.5$ B.t.u.

The loss in coal due to ash is 8.6 per cent of total = 1209.7 B.t.u.

A further loss in oil combustion is the heat absorbed by the steam used in atomizing, being in superheating the steam from 212 deg. to 500 deg. Fahrenheit.

This is: $288 \times .47 = 135$ B.t.u.

Tabulating these losses, which for convenience we will call fixed losses, we have:

	Coal.		Oil.
Gases	1219.8 B.t.u.		1529.4 B.t.u.
Combustion of H.	422.6 B.t.u.		1088.5 B.t.u.
Ash	1209.7 B.t.u.	Burner	135 B.t.u.
	2853 B.t.u.		2752.9 B.t.u.

While this calculation is not intended to convey any idea of the actual value of losses in the two fuels, it may however afford a comparison of what we may term fixed losses, within certain limits.

It is seen that the amount of air required for the combustion of coal is less than for oil. This is due principally to the greater hydrogen content in the oil, the carbon content being roughly speaking, the same. Furthermore the combustion of hydrogen requires a proportionately larger weight of air.

On the other hand the greatest loss in the coal is in the ash for in the comparison of the fuels we must consider them "as received." In the oil, loss due to non-combustibles is practically negligible. The loss due to superheating the burner is also small.

In examining our figures a remarkable equality of the total losses is immediately apparent. To what extent this relation would hold for coals of different composition would have to be determined.

Subtracting these losses from the calorific value of each fuel we have:

$$18619 - 2752.9 = 15866.1 \text{ B.t.u.}$$
$$14067 - 2852.1. = 11214.9 \text{ B.t.u.}$$

These last quantities represent the available heat left in fuel for evaporation. From this it would appear that the two fuels under examination had an evaporative value which is in the ratio of 11.2 for coal to 15.8 for oil. For coals equal in quality to that selected, the writer believes that this ratio will generally be correct, lower grade coals having correspondingly lower values. This ratio is maintained in numerous tests.

It is shown in the foregoing that the theoretically required air supply is greater for oil than for coal. This means a greater volume of flue gases hence a greater loss of heat. If we consider however, those coals having a large amount of volatile matter, it is safe to say that the air supply for their complete combustion would be much in excess of that for oil. Not knowing the composition of the volatile matter, we must necessarily figure with a certain indefinite quantity of excess air. In the combustion of oil we are able to supply more nearly that amount of air which is actually chemically required.

From the manner in which the oil is burned, it is evident that a more perfect mixture of air with the gases is obtained. Not only is the air supply easily regulated by hand, but apparatus has been devised to effect the control mechanically and automatically to suit momentary load requirements. Although it does not necessarily follow that a smokeless chimney signifies complete or most economical combustion, it does mean much to our neighbors and one can safely say that such a chimney is more often obtained in connection with an oil burning furnace than with one burning coal.

Evaporative tests have shown that for good coal an equivalent evaporation of 11 lb. represents about the highest average, although there are cases of higher results on record. For oil the highest average yet attained is probably an equivalent evaporation of 16 lb.

In the report of the Naval "Liquid Fuel" board the best evaporation with coal is given as 10.2 lb., while

with oil the best is 14.4 lb. In some forcing tests made some time ago (see Trans. A. S. M. E., Vol XXVI) by Mr. W. F. Dean, which are remarkable for the good reults obtained at that time, an evaporation for coal of 11.32 lb. was obtained. In a water tube boiler under ordinary conditions, using good coal, an average equivalent evaporation of 10 lb. can be considered good practice, although 11 lb. and slightly over is often obtained. Such results as these, it must be borne in mind, can only be obtained with the best grades of steam coal, similar or superior to the grade selected by the writer for comparison.

With oil fuel, in connection with water tube boilers, records show an equivalent evaporation of 14 to 16 lb. Test records in the writer's possession range from 13.6 to 15.4 lb. Latter is the record of the performance of a 150 h.p. Heine boiler in San Francisco. The oil used had a calorific value of 18,629 B.t.u. Gauge pressure 119 lb. Feed temperature 60 degrees. Flue gas temperature 480 degrees. Percentage of steam used for burner 2.8 per cent of total water evaporated or 0.36 lb. of steam per lb. of oil; 15.4 is the value after correction for steam to burner. Incidentally the efficiency of the unit is 79.8 per cent.

The figures given in the foregoing for oil can hardly be said to be due to any extraordinary construction or arrangement of furnace although care may have been shown in the selection of the burner.

In a series of eight tests made with a 66 in. by 16 ft. horizontal return tubular boiler, having 176, 2 in. tubes and using Coalinga oil of 22 gravity, 18,900 B.t.u. per pound of oil, the average evaporation of water from and at 212 deg. was 15.32 lb. The average h.p. developed at rate of 34.5 lb. of water per hour was 262.5.

The theoretical evaporation of the Coalinga 22 gravity oil, 18,900 B.t.u. per pound, being 19.56 lb. of water per pound of oil and the actual results having been an average evaporation of 15.32 lb., the fuel efficiency for this particular boiler was 78.5 per cent.

It is the writer's opinion that with a few more years' experience and a more refined and perfected fireroom and furnace arrangement, we will be able to reach evaporations closely approximating the theoretical limits. The ease of manipulation of the fire and the possibility of practically exact regulation of air supply for complete combustion, lend to oil fuel evaporative qualities that can be found in no other raw fuel.

FURNACE ARRANGEMENT FOR USING OIL AS FUEL.

BY C. R. WEYMOUTH.

In a paper presented at the New York meeting of this Society, December, 1908, Vol. 30, Page 707 of the Transactions, the writer gave various data regarding California fuel oil, air required for combustion, the various losses in oil firing, and a description of an automatic system for the regulation of boilers fired with crude oil. Although the subject assigned properly includes the question of air supply for combustion, the writer, by reason of his former paper will devote himself mainly to the question of furnace design, and this only for stationary water-tube boilers.

About twelve years ago the low cost and certainty of supply of crude oil led to its general use in California boiler plants. At that time, with a few notable exceptions, there were none but the crudest methods for burning oil, the owner usually employing one of the numerous improvisors of oil burners to convert his plant. This operation usually consisted in introducing a burner through the fire doors and covering the grates with fire brick. This plan was occasionally modified by the introduction of different forms of fire brick arches, target walls, checker walls, etc. Many of these converted coal burning furnaces caused frequent burning out of boiler tubes, due to the localization of heat; gave a limited overload capacity; and by reason of various defects of furnace design, coupled with a general ignorance of the question of oil burning, gave in most instances little better than mediocre results.

During the early period, Mr. E. H. Peabody of New York, a member of this Society, then testing engineer of the Babcock & Wilcox Co., began the first extensive engineering investigation of the merits of various type of furnaces, burners, etc. After an extensive series of tests, lasting nearly two years, Mr. Peabody developed an oil furnace bearing his name, now in general use with certain types of water tube boilers.

Mr. Peabody's tests indicated that while there are differences in various types of burners, these are relatively unimportant; that the proper design of furnace is of supreme importance, as determining efficiency and capacity of boilers and immunity from shut down owing to tube burn outs, etc.; that fire brick arches and target walls are not only needless in securing high furnace efficiency, but a menace to continuity of operation, owing to the impossibility of even the best grades of fire brick withstanding the intense heat of an oil furnace; that furnace depth and furnace volume are determining factors affecting furnace efficiency and capacity, and affording protection to the boiler heating surface, particularly when the character of boiler feed water gives rise to an accumulation of scale inside of boiler tubes; that the shape of furnace and path of flame must be such as to provide a nearly uniform distribution of furnace heat over the largest possible portion of boiler heating surface, as distinguished from an arrangement, causing the direct impingement of flame on a few inches of the tube length; that a large surface of heated fire brick is essential to the maintenance of a high furnace temperature and complete combustion of oil; that air for combustion should be admitted through carefully planned openings in the floor of furnace in such a manner as to provide the most intimate contact of oil flame and incoming air, and thus reduce the air supply to a minimum; that the flat flame or fish tail burner provides for the most economical use of air for combustion; and that when all these requirements for highest economy are observed, the furnace flame has not the bright incandescence sought by the pioneers in oil burning, but surprisingly borders on an orange red.

In the Peabody furnace the bridge wall is set back from the boiler front to give a depth of from eight to ten feet, depending on size of boilers. The burner is of the back shot type, inserted from the boiler front, under the floor of furnace, turning up at the bridge wall. It shoots the flame forward toward the front

of the boiler, so that this wall should have an extra course of fire brick set in place without fire clay, affording an added protection to the front wall. With boilers having tubes inclined downwards, from the front toward the rear, there is thus provided a furnace design, of a shape giving the necessary increased volume as the flame slows away from the burner, providing a gradual distribution of the furnace heat over the tubes the full length of the furnace, there being at no point a direct impingement of flame.

At its front end, except in special boilers, the furnace should have a height of not less than six feet and for large size boilers the height should be from seven to eight feet, depending on character of feed water and desired overload.

Under ordinary firing, the flame should not extend into the tubes, but at forced firing the flame will extend part way through the first pass.

Under Babcock & Wilcox boilers, Mr. Peabody's record performance of 1903 was 83 per cent efficiency at rating, based on 10 sq. ft. of heating surface per boiler horsepower; and an overload capacity of 110 per cent above rating.

During the boiler trials at the Redondo plant, Dr. B. S. Jacobus, a member of the Society, obtained boiler efficiencies on large Babcock & Wilcox boilers, which exceed any published records, the details of which he will soon make the subject of a special paper, to be presented to this Society.

When admitting a large excess of air and an ordinary amount of oil, the flame length will be a minimum, and the temperature of incandescence will be reached at the surface of the envelope separating the vaporized oil and air for combustion. This bright flame is sought by the untrained fireman, but it results in a large loss of fuel, as the subsequent mixture of the products of combustion with the excess of air not in contact with the flame results in a lower mean furnace temperature, which temperature determines the boiler efficiency.

With economical firing the flame lengthens before coming in contact with sufficient air for complete combustion, and with the highest furnace efficiency this temperature varies from 2500 to 2800 degrees Fahrenheit.

Due to the high furnace temperature with oil fuel, as also with coal, the location of furnace relative to boiler heat absorbing surface becomes of utmost importance, not only on account of the loss of heat, due to excessive travel and consequent radiation from furnace walls, but also by reason of the large amount of heat absorbed by direct radiation as distinguished from convection. Consequently the first pass of the boiler should be located directly over the furnace, providing the most direct transmission of the heat generated, both by convection and absorption of radiant heat.

Owing to the large area of incandescent fire brick surface, the radiant heat is uniformly diffused over a large heating surface and the amount of heat thus absorbed becomes an important factor in determining the efficiency of boiler heating surface; for while no heat can be ultimately lost, the greater the heat absorbed in the first pass of the boiler, the lower will be the temperature of gases on entering the second pass, and finally the latter passes of the boiler are able to accomplish greater cooling of the products of combustion resulting in the lowest possible stack temperature; hence the maximum absorption efficiency of boiler.

The time allowed for this discussion is not sufficient to cover other practical considerations in furnace design, such as the number of burners per furnace, arrangement of burners in furnace, arrangement of checker work for air supply, peep hole doors, etc.

While there are inevitable losses in furnace efficiency and boiler efficiency, when operating on a commercial load under ordinary firing, it is the writer's belief that under test conditions the practical limit of boiler and furnace efficiency with oil fuel has already been attained. Considering the ideal nature of oil fuel, by reason of which one can under test conditions, with proper furnaces, cut down air supply to nearly the required theoretical quantity, one might reasonably inquire the reason for the inability to attain still higher furnace and boiler efficiencies. The answer is at once found in the chemical analysis of oil fuel and the large hydrogen content. If it were possible to obtain and burn liquid carbon with the minimum air supply required for oil fuel, maintaining the same radiation and unaccounted-for-losses, and the same terminal temperature of boiler gases, it would be possible to attain a gross boiler efficiency of approximately 90 per cent.

It is still the universal practice in this country to report the heating values of fuels as that shown by a calorimeter test which, as is well known, indicates the total heat of the fuel, including the latent heat liberated by the condensation of the steam formed by the combustion of the hydrogen content, instead of the available heat. If boiler efficiencies with oil fuel were reported on the basis of "available heat," test performances already secured would also indicate boiler efficiencies approximating 90 per cent.

For these reasons it is possible to obtain higher boiler and furnace efficiencies with crude oils of low gravity and least hydrogen content, than with oils of lighter gravity high in hydrogen; and this conclusion is borne out by tests.

PRACTICE AS TO SIZE OF STACKS WITH OIL FUEL.

BY J. P. DUNN.

The question of stack areas and draft depends on the quantity of fuel burned and the necessary draft required. In coal burning we have the necessary draft required to overcome the friction of the fuel bed, which runs anywhere from 35 to 70 per cent of the total draft head. This is eliminated in oil burning furnaces, and consequently a shorter stack will answer. From 80 to 100 feet is all that is necessary. In coal-burning plants stack sizes are accepted which are based on 5 lb. of fuel per boiler horsepower. If with that stack we change to oil we have 2½ lb. per boiler horsepower; and considering that oil can be burned with a smaller amount of excess air than coal, we have virtually two to one, and the stack area would be sufficient for double the horsepower. There are a great many stacks that are operating successfully on

a basis of fifty per cent of Kent's Table. I have a record of one stack that has been forced to the limit, which shows 35.7 per cent. In this particular plant, when they reach that point the pressure under the furnaces is so great that the gases pass out through the cracks in the setting and through the boiler bridging. There is one point in connection with that, which I do not believe is given the attention that it should, it is the question of bridging area; ordinarily the effective area is not considered, as in many plants the bridgings are narrow and long, and in several instances that I know of the effective areas are in the neighborhood of 70 to 80 per cent of what they should be. I know this to be a fact because I have been up against the same propositions. We can take it as standard practice that fifty per cent of stack areas of Kent's tables are ample for oil fuel.

MARINE USE OF FUEL OIL.

BY J. H. HOPPS.

As a fuel for steamships, petroleum has many advantages besides that of low cost. The most important of these are:

(1) The saving in labor and consequent reduction in the number of firemen. The amount of money saved varies with the size of the ship and the number of firemen carried. In installations of average size, one-third the number of firemen and coal passers necessary when burning coal would be sufficient when burning oil.

(2) Reduction in weight and bulk of fuel, giving increased cargo capacity and resultant greater earning power. Comparing "Wellington screenings," a type of coal generally used for steamship work on the Coast and fuel oil from 14 to 17 Baume, oil for equal heating value occupies about one-half the space taken by the coal and has less than one-half the weight. Oil may be carried in parts of the ship not otherwise useful.

(3) Saving in time. The time consumed in coaling and expense of moving to bunkers is saved as oil fuel can be pumped into the ship when she is at the dock and while the cargo is being taken on or discharged.

(4) Uniform steaming. The rate of steaming can be kept perfectly uniform, there being no loss due to cleaning fires, etc.

(5) Cleanliness. Due to the absence of coal dust and dirt when coaling and to the absence of ashes in the fireroom.

(6) Reduced cost of maintenance. Less repairs on boilers due to uniform temperature in furnace and combustion chamber; no corrosion of floor plates, fire fronts, or bunkers; no grate bars to burn out, and no fire doors or ash handling machinery to renew or repair.

That the advantages of oil as fuel are recognized is evident from the large number of steamers using it. Some of these vessels are of large size and make long voyages; notably, the ships of the Hawaiian American Steamship Company, the steamers Tenyo Maru and the Chiyo Maru of the Toyo Kisen Kaisha Company, the steamers "Sierra" and "Mariposa" of the Oceanic Steamship Company, and the numerous large tank steamers owned by the Standard Oil, Associated Oil and Union Oil Companies.

The comparative cost of coal and oil for fuel depends on the price of the fuels and the heat values of coal and oil respectively. Conditions in California are especially favorable to oil. Coast coals are high in price and low in heat values, while oil is low in price and high in heat value. It is not possible to give exact figures as to the saving effected by the use of oil in preference to coal for fuel as the prices of both are constantly changing.

Some instances, however, may be quoted. In the report of the Naval Liquid Fuel Board, published in 1904, figures are given covering the performance of the steamship "Nevadan" of the Hawaiian-American Steamship Company. The figures given cover one voyage from New York to San Diego, burning coal, a return voyage from San Diego to New York burning California oil, and three other voyages burning oil. The records of the two first voyages are of value as showing the relative consumption of coal and oil under similar conditions. Full particulars are given of both voyages, but for present purposes it is sufficient to quote the following:

Total indicated H P.	Fuel.	Total consumption of Fuel.	Coal per I.H P.	Oil per I.H.P.
Voyage 1—1835	Coal	2269 tons	——	——
Voyage 2—2196	Oil	9126 bbls	2 lb.	1.1 lb.

The heat value of the coal used in the first voyage is not given, and as a consequence the comparison is not so effective as it might be. Of the total coal burned, part was Eureka and part Coronel. The figures given for the second voyage may be said to represent an exceptionally fine performance. The steamer was new, is fitted with triple expansion engines, the Howden system of forced draft, and the Lassoe-Lovekin oil burning system.

Burning oil, six men were required in the fireroom as against fifteen when burning coal. Four hundred and fifty-seven tons of measured space for cargo was saved on account of the decreased bulk of oil fuel. The financial gain to the company from all causes is given as $500 per day.

In the case of a small coasting steamer coming under the observation of the writer, careful records were kept of the fuel cost, both with oil and coal. The cost of fuel per hour of actual steaming averaged, for a period of six months:

Coal at $5.25 per ton ....$2.65 per hour
Oil at .70 per barrel .... 1.64 per hour

It is to be regretted that few tests have been made to determine the efficiency of steamship equipments. It is more difficult to make such tests on board ship than in a stationary plant. The installation of apparatus for accurately measuring fuel and feed water, the changing of the piping, and the services of trained observers entails heavy expense and loss of time.

The only guide then to the efficiency of oil burning installations at sea in actual service, is the engineer's log, and this, unfortunately, is far from accurate. The oil burned is determined by sounding the oil tanks and as a rule the only clue to the h.p. developed is the number of revolutions made by the main engines, the h.p. of the auxiliaries being always a matter of uncertainty.

In 1903 a series of tests were made by Mr. T. W. Ransom on the tugs "Richmond" and "A. H. Payson," owned by the Santa Fe Railroad Company. As these vessels ply only on San Francisco Bay and in smooth water, the installation of platform scales to weigh the feed water and fuel oil was feasible. The tests were made with great care, a number of observers being employed and all essential data recorded to show the efficiency of the entire installation and the efficiency of boilers and engines, separately. The detailed data secured was destroyed in the fire of 1906, there remaining only a summary of the results.

The machinery of the two vessels is identical with the exception of the boilers.

The tug "Richmond" is fitted with a boiler of the Scotch marine type, 13 ft. mean diameter by 11 ft. long, with three Morrison furnaces 3 ft. 6 in diameter by 7 ft. 10 in. long and 230 tubes $3\frac{1}{2}$ in. diameter by 7 ft. 10 in. long. The depth of the combustion chamber is 36 in. and the total heating surface is 3136 sq. ft.

The "A. H. Payson" is fitted with a Babcock & Wilcox marine water tube boiler, with a total heating surface of 2770 sq. ft.

The engines in both cases are compound, high pressure cylinders 20 in. diameter, low pressure cylinders 43 in. diameter and stroke 24 inches.

A large number of tests were made on these vessels in service, when towing car-floats to and from Point Richmond. In addition, a five-hour test running steadily without a tow was made on each boat, when the following results were secured.

FIVE-HOUR RUN—TUG A. H. PAYSON—AUGUST 2, 1903.

Time	Rev. Per. Min.	Horse Power	Water Used	Oil Used	Water Evap. Actual	Water Evap. From & at 212°	Factor of Evap	Water per I.H.P	Oil per I.H.P.	Speed Knots
11.00										
12.00	95.3	535	11475	853	13.4	14.68	1.095	21.4	1.59	
1.00	96.0	523	11326	837	13.5	14.77	1.094	21.6	1.60	
2.00	94.5	509	11418	809	14.1	15.32	1.087	22.4	1.58	11.72
3.00	95.5	498	11300	826	13.6	14.66	1.078	22.9	1.65	10.63
4.00	96.4	537	12251	845	14.6	15.84	1.085	22.9	1.56	11.65

FIVE-HOUR RUN—TUG RICHMOND—AUGUST 24, 1903.

Time	Rev. Per. Min.	Horse Power	Water Used	Oil Used	Water Evap. Actual	Water Evap. From & at 212°	Factor of Evap	Water per I.H.P	Oil per I.H.P.	Speed Knots
12.00										
1.00	91	418	9532	829	12.2	12.80	1.140	22.8	1.98	
2.00	92	424	10331	835	12.4	14.10	1.143	24.3	1.97	
3.00	91	418	8831	806	11.0	12.55	1.140	21.1	1.92	11.08
4.00	91	418	10496	833	12.2	13.90	1.140	25.1	1.99	10.04
5.00	91	418	9627	865	11.2	12.90	1.150	23.0	2.06	10.75

AVERAGE FOR FIVE HOURS' RUN.

	Rev. Per. Min.	Horse Power	Water Used	Oil Used	Water Evap. Actual	Water Evap. From & at 212°	Factor of Evap	Water per I.H.P	Oil per I.H.P.	Speed Knots
Payson	95.5	520	11553	834	13.8	15.05	1.089	22.2	1.59	11.15
Richmd	91	419	9743	833	11.8	13.05	1.142	23.2	1.96	10.47

From examinations of the logs of numerous steamships, it appears that vessels fitted with triple expansion engines developing from 1000 h.p. up, with everything in first class condition, the fuel consumption will be about $1\frac{1}{4}$ lb. of oil per i. h.p. hour. For smaller vessels fitted with compound engines, the consumption will range from 1.6 to 2 lb. per indicated h.p. hour, depending on the efficiency of the plant.

In considering the installation of an oil fuel equipment, the subject is naturally divided into two parts. The first relating to the storage and handling of the fuel and the second, relating to arrangements for its combustion.

Under the first division, the safety of the ship and those on board is the first consideration, and after this comes convenience in handling fuel and accessibility of all the important parts.

Under the second division should be considered the system for burning oil, type of burners, and furnace arrangement.

In order to render a fuel oil installation safe, careful attention must be paid to the construction of the tanks in which oil is stored. Not only should the best workmanship, the best methods of support and the best quality of riveting be insisted upon, but great care should be exercised in the design of the ventilation system. Air pipes should be fitted to all tanks, of sufficient size to lead off gases as they accumulate and to prevent any undue pressure on the tanks due to too rapid pumping when they are being filled. The ventilating pipes should be lead as directly as possible to above the uppermost deck of the vessel. They should not be near the smokestack and should be placed where it will be impossible for a naked light to be near them. The openings should in all cases be covered with wire gauze carefully secured. Furthermore, the workmanship on all pipes, valves, and fittings should be of the very best quality. Great care should be taken that all joints are tight, as the leakage of a very small quantity of oil may result in a formation of a large volume of gas from which a disastrous explosion or a serious fire may result.

In a steel vessel fitted with double bottom, the fuel oil may be stored in the compartments in the double bottom usually devoted to water ballast, or in deep tanks constructed for the purpose and usually extending entirely across the ship. The former method is open to several objections, but is often adopted, owing to its low cost and saving in space, where deep tanks. are used, expansion trunks should be provided.

In the case of wooden vessels, separate steel tanks independent of the structure of the ship are provided. The location of these tanks varies greatly, depending on the trade in which the ship is engaged, and the preference of the superintending engineer. They are frequently placed in the space formerly occupied by coal bunkers, in the fore-peak, and often, on deck.

The use of the double bottom for oil fuel is open to several objections. The tanks being shallow and divided into a very large number of compartments by the floors, keelson, and intercostals of the ship, it is very difficult to completely fill them owing to the amount of air trapped in the different compartments. It is also impossible to empty them entirely and when a tank is only partly filled, trouble may be experienced in pumping out the oil when the ship is rolling. Again if the ship has to go far north or south where the water is cold the oil in the double bottoms congeals and diffiulty is experienced in pumping. With many cargoes it is necessary to fill the compartments of the double bottom with water ballast when the oil is pumped out and this means that at all times there will be a considerable quantity of water present in the oil. When the double bottom is used, it is necessary to provide settling tanks in or near the fireroom, into which the oil is pumped from the ballast tanks, before being pumped to the burners. The object of these settling tanks is to permit the removal of any water which may have found its way into the oil tanks, or which may be in the oil when it is loaded. These settling tanks should be of sufficient size to contain from eight to twelve hours supply. They should be in duplicate and fitted with steam coils for heating

the oil, gauge glasses to show the amount of water in the bottom of the tanks, and connections for the oil pumps and for pumps to draw off water which has settled out from the oil.

Oil Burning: The important features of this part of oil burning equipment are the atomizer and the furnace arrangement. On these depend the efficiency of the system. The importance of proper furnace arrangements with means of controlling and directing the supply of air and fuel has been emphasized in previous discussions. In the case of marine installations, it is not always possible to secure the best furnace arrangement. Nearly all the steamers in commission today are equipped with boilers of the internally-fired type. With the short cylindrical furnaces of comparatively small diameter used on these boilers, it is difficult to secure the highest possible efficiency when burning oil. They are well adapted for the burning of coal.

For the burning of oil, it is well known that ample combustion space is needed. With a large combustion space, greater time is available and more opportunity for the oil particles to take up their requisite supply of air for combustion. Further, it is important, as has been pointed out, that the direction of the incoming air current should be such as to cause an intimate mixture of the air supply and oil particles as early as possible. With the short cylindrical furnaces these conditions are difficult of attainment. The air and fuel are admitted in sensibly parallel paths. The furnace is short and of small diameter, hence, the time during which fuel and air are in the furnace is very short. In consequence, complete combustion is difficult and is always delayed. With water tube boilers, the furnace conditions are superior, and as may be expected, higher efficiencies have been shown.

Atomization: Three systems of atomization are in use in marine installations, namely: Steam, Air and Mechanical.

Of these, by far the greater number of installations in use on the Pacific Coast are of the second order. The use of steam for atomization is confined to vessels plying in inland waters, or on very short runs. It is not suitable for vessels making voyages of any length because of the large amounts of fresh water necessary for boiler feed to make up the loss due to the steam used for atomizing. This feed water must be carried in tanks, thereby reducing the cargo capacity of the ship, or changing the arrangement.

Air is used for atomization in almost all vessels making voyages to sea. The air is used with varying pressures from 1½ to 60 lb. per sq. in., depending on the burner. By far the larger number of oil burning outfits utilize pressures in the neighborhood of 20 lb. per sq. in.; the air being supplied by steam driven compressor, or in the case where low pressures are used, a rotary blower.

The third system, mechanical atomization, quite generally known as the "Koerting" or "Meyer" system, although extensively used in Europe, has not yet been adopted to any extent on the Pacific. The atomization is effected by expelling the oil through a small orifice partly closed by a plug, on which is formed a spiral thread. The edges of the orifice are sharp and the spiral thread imparts to the stream of oil a rapid whirling motion, causing the oil to break up into fine drops which leave the nozzle in a cone of atomized oil upon which the entering air currents impinge.

As has been said earlier in the discussion, little data is available showing the efficiency of marine oil installations. The amount of steam required for atomization will range from 2 per cent to 8 or 9 per cent depending on the type of burner and the intelligence with which it is operated.

For air atomization and with air pressures from 20 to 30 lb. per sq. in., from 6 to 10 cu. ft. of air per minute per pound of oil burned will be required. The amount of air depending on the construction of the burner and the pressure at which it is used.

For air atomization with low pressures, such as can be produced by a rotary blower, of which the Lassoe-Lovekin system as fitted to the steamships of the American Hawaiian Steamship Company, is an example, the amount of air required for atomization is not known. The air pressure used is 1¼ lb., and all the air is heated by the Howden system. The oil is heated to 175 degrees F. As evidenced by the figures given heretofore, for the steamship "Nevadan," this system shows a high efficiency.

A few installations of the third, or mechanical system, have been made on the coast, but no information is available as to the efficiency obtained.

In the opinion of the writer, the mechanical system has not received the attention which it deserves from our local engineers. It should be efficient and its simplicity is certainly a recommendation. I am informed by the agent of the Koerting Company that the oil may be handled by the ordinary pumps installed for that purpose, with other systems, but that an additional heater is necessary as the temperature of oil at the burner should be from 240 to 260 degrees. It is further stated that as long as the pressure of oil at the burner tip is maintained at more than 40 lb. per sq. in. there will be no carbonization in the heating and pipe system, nor in the burner. One hundred lb. per sq. in at the burner is said to be the most desirable pressure for this system.

The makers state that to operate the pumps and supply the heat to the oil necessary with this system takes from ¾ to 1 per cent of the steam evaporated.

Some large tank steamers fitted with the mechanical system are said to operate satisfactorily. The results obtained show that a horsepower is developed for from 1.09 to 1.37 lb. of oil per indicated h.p. per hour, for all purposes. These vessels develop about 1900 h.p.

ATOMIZATION OF OIL FUEL.

BY A. M. HUNT.

In order that petroleum may be burned with complete combustion it is necessary that it be either gasified or injected in the form of spray into the furnace in which it is burned. Some forms of small pan burners have been devised for use in hot air furnaces, where oil drips into the pan, and burns from the surface, but they are of no importance in power or industrial work.

The general practice is to deliver the oil to the

burner under head, and inject and pulverize it, using steam or air as the pulverizing medium.

The oil injected into the furnace should be entirely gasified or burned while it is in suspension in the air, otherwise if particles of unconsumed oil fall to the bottom of the furnace, coke will be formed, which gradually accumulates and builds up.

A number of factors enter into the production of the results required. If the oil is being injected into a cold furnace, that is one not enclosed by walls of brick or other material which becomes highly heated, the oil must be injected in a spray composed of fine particles, in order that none of the particles shall fall to the bottom unconsumed. If the walls are highly heated, the radiation from them will aid greatly in vaporizing the oil particles, and larger particles will be consumed before they drop.

If the furnace is short, the oil particles will have a relatively short time period within which they must be consumed, and must, therefore, be smaller.

It is evident that anything which will enable the oil more easily to be atomized, or that will aid in vaporizing an oil particle after it is injected into the furnace, will help to reduce the quantity of atomizing medium required, whether it be steam or air.

Most of the oils used for fuel are of a heavy and viscous character, and their viscosity is rapidly reduced by rise in temperature. It is, therefore, desirable that the oil fed to the burners be preheated, and it is almost universal practice to do so. The preheating is usually accomplished by passing the oil through a heater similar in type to a closed feed water heater, using the exhaust steam from the pumps handling the oil.

Hundreds of burners have been invented, and great claims have been made by each inventor as to the possible saving to be effected with his particular form. The burner is really an item of minor importance in all oil burning installation, as compared with furnace construction, proper air admission, and other points.

The office of the burner is simply to inject the oil into the furnace in a spray having a form suitable to the shape of the furnace, and the surfaces which are to be heated, and in particles sufficiently small so that they may be fully consumed before impinging on the hot bottom or walls of the furnace.

The burner should be so built that the relative areas of openings for issue of oil and atomizing medium can be maintained, or if they become enlarged by scoring, that adjustment can be readily and inexpensively made.

Some work has been done in the direction of atomizing the oil without the use of air or steam. The oil having been pre-heated to temperatures of from 220 to 260 degrees Fahrenheit is injected into the furnace through a needle nozzle, having a small sized orifice. The portion of the needle stem inside the cylindrical part of the nozzle, has cut on it a screw thread, which imparts to the issuing oil a rotary motion. The release of pressure on the heated oil, and the rotary motion imparted to it, cause it to issue in the form of a spray in a state of sub-division fine enough to enable it to burn successfully.

I give below some data as to amount of atomizing medium required for spraying oil fuel, which has been obtained from various sources.

Data as to Amount of Steam Required for Atomizing Fuel Oil in Boiler Furnaces, Collected From Various Sources.

CASE 1:

Steam to burner per pound of oil	.537	
Actual evaporation per pound of oil	13148	
Percentage	4	

CASE 2:

Steam supplied to burners per hour	4373	lb.
Actual evaporation per hour	96881	
Percentage	4.5	
Steam per pound of oil for atomization	.529	

CASE 3:

Steam supplied to burners per hour	7087	lb
Actual evaporation per hour	174820	
Percentage	4	
Steam per pound of oil for atomization	.485	

CASE 4:

Steam supplied to burners per hour	5746	lb
Actual evaporation per hour	144079	
Percentage	4	
Steam per pound of oil for atomization	.475	

CASE 5:

Steam used was measured by use of separate boiler.
Oil used 34½ degrees Baume.
Total evaporation per lb. of oil from and at 212 deg...14.99 lb
Percentage of steam evaporated, used by burner 7.4%

CASE 6:

Steam used was measured by calibrated nozzle.
Total evaporation per lb. of oil from and at 212 deg...14.7 lb
Percentage of steam evaporated, used by burner 2.5%

CASE 7:

Steam used was measured by calibrated nozzle.
Total evaporation per lb. of oil from and at 212 deg...14.2 lb
Percentage of steam evaporated, used by burner 3.6%

CASE 8:

Steam used was measured by use of separate boiler.
Total evaporation per lb. of oil from and at 212 deg...15.2 lb
Percentage of steam evaporated, used by burner 2.39%

From tests made under the direction of the Bureau of Steam Engineering in 1902, the following data is taken:

Four tests were made using steam as the atomizing medium. The percentage of total evaporation used by the burners ranged from 3.98 to 5.77 per cent. A number of tests made under Stirling water tube boilers gave results ranging from 3.1 to 3.42 per cent.

From the above data and general practice and experience, the following statement can be made:

In designing a plant it is entirely safe to assume 5 per cent of the evaporation of the boilers for steam supply for burners. In operation, if the amount is greater than 3 per cent, it may be concluded that the condition can be bettered.

The use of compressed air for atomizing fuel oil may be stated to offer no opportunity for fuel saving over the use of steam direct in cases where steam is available. The use of steam direct obviates complication, and risk of interrupted service, and the use of compressed air is not justified unless there is some special reason for it.

It may be that steam cannot readily be had, and that a motor-driven compressor can easily be installed.

It may be that where steam is available, the loss of water through steam supplied to the burners is undesirable, as in the case of sea-going steamers.

In certain metallurgical and industrial operations, especially where high temperatures are desirable, the use of air is to be preferred.

In rotary cement kilns, using oil fuel, compressed air, as the atomizing agent, is universally employed so far as I know.

Reverberatory furnaces for metallurgical operations, using oil fuel, employ compressed air as the atomizing agent.

Data as to Amount of Air Required for Atomizing Fuel Oil, Collected from Various Sources.

Case 1: Rotary cement kiln, 7 ft. 6 in. diameter by 125 ft. in length, producing about 500 barrels of clinker daily. Air used under pressure of approximately 80 lb. A single burner used, delivering oil at the rate of about 4 gallons per minute. The weight of air required for atomization is approximately 25 per cent of the weight of the oil atomized.

Case 2: Data furnished by air compressor manufacturer as to capacity of compressor furnished for boiler installation of 2500 h.p. Assuming that the entire capacity of the compressor was necessary, this figures out a use of air amounting to approximately 55 per cent of the weight of fuel atomized.

The same manufacturer gives the following data: For marine boilers figure one cubic foot of free air for each five boiler horsepower, the air being supplied at a pressure of about 25 lb. A ten cubic foot compressor at 20 lb. will supply air sufficient to atomize the fuel oil to take care of a boiler furnishing steam heat for a small apartment house. For burning sewer pipe it takes about 5 cubic feet per minute for each burner using about five gallons per hour of oil.

He adds the following comment: "We favor the use of air as hot as we can get it from the compressor, cutting out the water jackets."

Case 3. Reverberatory copper matting furnace. Hearth 80 ft. long by 17 ft. wide. Center of roof arch is about 30 in. above the surface of bath on hearth. Fired from the end using four burners. Amount of material smelted per day, 182 tons. Oil used per day, 36,472 lb. Air for atomizing supplied by a motor-driven Connersville blower at 9 lb. pressure. Amount of air used, about 50 per cent of weight of oil burned.

"OLLA PODRIDA."

BY THE CHEERFUL IDIOT.

Olla Podrida—figuratively means a literary production of very miscellaneous contents.—Encyclopedia.

The session of the California Legislature at Sacramento is drawing to a close. They have left undone those things which they ought to have done, and have done those things which they ought not to have done, and there is no health in them. "Errare humanum est." One thing in particular that they have left undone and which I suppose is of more interest to many of the readers of this paper than anything else at this time, is to act favorably upon the passage of the Engineers' License Law, a measure desired by all the engineering fraternity throughout the State.

I feel like asking here: Why is an engineer? Frankly, I don't know. I can't answer my own question. Should any reader of this paper while walking along our streets see two men meet who are acquainted with each other, he will, if he happens to be in a frame of mind to notice them at all, hear one say to the other, "Well how goes it?" or "How are you, what do you know?" The reply to the last half of the latter question generally being, Nothing! Now when two engineers meet the method of procedure is quite different; they meet in silence; watch them closely. They will approach to within about three feet of each other, and standing still will extend their hands at the level of the waist with fingers closed and thumbs pointing downwards. This is the first position. It is immediately followed by the second. The hands are raised to the level of the breast bone, the arms are extended at full length, fists closed, and placed perpendicularly one above the other. The two men then pass on their respective ways in silence. These are engineers. The first portion of the sign has two meanings, viz: "We are under the thumb," or "We are the under dog." The second portion of the sign means, "We grasp with might and main the slippery end of the stick. Should we let go; it is all off with us." Before I knew what this sign meant, a man made it before me. I thought he was going to have a fit. It doesn't take very long to make it but when thoroughly understood it is very expressive.

Now the engineers of the State of California have been trying to get some sort of a law passed whereby members of the craft should be licensed, for the past 25 years, and they have always gone about the matter in a business-like, upright way, thinking that a law of this kind would be of great benefit alike to the employer and the employee. The funny thing about it is this: that nobody else looks at the matter in the same light. And the opposition encountered by the engineers is wonderful. The first bill prepared about 25 years ago was drawn up by members of the N. A. S. E., who at that time stood alone in the fight. The bill which has failed to pass at this session of the Legislature was jointly prepared by the L. W. S. E. and the N. A. S. E. and was adopted and endorsed by all the union engineers and N. A. S. E. men throughout the State. Of course there were a few individuals who did not endorse it, but majority rules always.

As soon as the bill was submitted to the Legislature the fun commenced. The capitalists and steam users claiming that it was only a "subterfuge," got up by the trades unions to coerce them into paying good wages for services which they could now get cheaply. And the trades unions claiming that the whole thing was a Citizens' Alliance movement designed to get the engineers away from under their thumbs.

Under the circumstances, therefore, it seems to me in my humble judgment, that the poor engineer is in a h—l of a fix. It is entirely wrong to accuse the engineer of trying to "subterfuge" in the case at all. They tried by all honorable means to attain an honorable end.

Not so with the man who wanted to ship a large shipment of limburger cheese by rail. He tried a "subterfuge." In looking over the freight rates he found them to be prohibitive, but in still looking further over the tariff sheet he found he could ship a corpse for half rates. So he bought a cheap coffin, filled it with the cheese, enclosed it in the usual redwood box and accompanied it himself. Having traveled some miles he went into the baggage car to see how his "subterfuge" was getting along. While looking at it the baggage man said:

"Traveling with the corpse, sir?"

"Aha, yes!"

"Relative of yours, I suppose?"

"Aha, yes; my brother."

"H'm; well he's dead alright."

This was a "subterfuge." The engineers' bill wasn't.

Just fancy the peculiar spectacle of a Citizens' Alliance man on one side of the table and a trades union man on the other, in Sacramento, both opposing the engineer. Something ought to have happened. I am looking at this subject, or at least trying to look at it in a disinterested light, and in all fairness to both sides. I masquerade as an engineer and have been in the business in California for nearly 30 years. I have got along during that time without a license. Inasmuch as I shall not live 30 years more, perhaps it won't make any difference to me personally whether I ever get a license or not. But I want to go on record as saying that I sincerely hope that the engineers will obtain what they want sooner or later. The vaporings of a "Cheerful Idiot" perhaps won't help them much, but they have my very good wishes for their ultimate success. What I was going to say, however, was this: Either the Citizens' Alliance should have gone over to the engineers' side tooth and nail to beat the unions—or the unions should have gone over to the engineers in the same way to beat the Citizens' Alliance. As neither one of these things happened, the engineers fell down with great completeness and with a very loud noise. In one of my previous effusions which this paper was kind enough, or otherwise, to print, (which ever way the many readers care to look at it), I stated that I had attended a meeting of our organization at which the subject of a license law was brought up. At that meeting the mention of the license law had the most astonishing effect. Everybody went up in the air like a lot of kites. I was grateful to be allowed to get home with a whole skin. These men seemed to me to be entirely opposed to any measure to license the engineer. I made a speech, and even that didn't do any good, but in my speech I pointed out to them the advantage as I saw it of having a California license for engineers, and on very simple grounds. We have secured the 1915 Fair here. Would it not be much nicer for men who live in the State, many of whom were born and raised in the State and who are in turn raising or helping to raise the future population of the State, to have the engineering jobs pertaining to the "getting ready" of this great enterprise in their own hands, instead of standing around shaking a bunch of keys and a knife in their pockets and admiring the beautiful climate and our beautiful bay, etc., while outsiders do the work?

As an illustration let me cite an example. I once played in a band. We finished a pleasant and prosperous engagement in a nearby town. A few days later and just previous to Labor Day, I met the solo cornet player on the street and asked him if he had anything on for Labor Day. "Oh, yes," said he, "I have a big band for that day, but I need a bass drummer; I think I'll give the job to Frank Moore." "But," said I, "Frank is not a drummer, he is a piano player, and besides he has no drum." "Oh, well," said he, "that don't matter, he can borrow yours." Now, I didn't look at the matter in this light at all. I failed to see how I was going to profit in any way by the arrangement. I was supposed to stand on the street corner, admire our beautiful climate, our beautiful city, our beautiful bay, and so forth, and watch another man making $8 out of my drum.

Nearly all the engineers in the State are affiliated with the union, and the union is affiliated with the Labor Council and the Building Trades Council. The engineers have to pay dues, per capita tax, assessments, strike benefits and what not. They always come through, they have to; but when they try to get up something to better themselves these very organizations oppose them to the limit. The chicken picker won't pick a duck—he goes on strike. What's the proper thing to do under the circumstances? Why, the only logical thing to do is to assess the engineer, and he gets it. Hooligan falls into a sewer and breaks his neck. Up comes an envelope containing ten raffle tickets for his pick and shovel for the benefit of the widow. Now the engineer has no more use for a pick and shovel than a cow has for a fire balloon, but he has to be a good dog and buy a ticket.

A farmer once owned a jackass which he had great trouble in catching in the morning. The only way he could catch him was to go out just at break of day, creep up close and throw a rope round his ass's neck. One morning he went out as usual, but it happened to be very foggy. He crept around in the dark until he saw what he supposed was his ass, lying down. He made a jump; unfortunately, however, he was mistaken. What he thought was his ass was a stone curbing around an empty well. He went over this, landed at the bottom and broke his neck. The coroner's jury subsequently sat on the case, and returned a verdict to the effect that the farmer had come by his death through falling down a well and breaking his neck while looking for his ass. And gave it as their opinion that this was the only authenticated case on record where a man didn't know his ass from a hole in the ground.

I was in Sacramento the night that the engineers' bill was brought up for final action before the Law and Judiciary Committee of the Senate. I don't exaggerate in the least when I say that there were $10,000,000 represented there flanked by the best and most expensive legal talent in the State opposing the license bill. There were two engineers there with perhaps not more than $20 in their pockets, between them. Great chance.

The newspapers look upon the matter in a way which to an engineer seems most peculiar and absolutely illogical, the writer of some of the editorials displaying profound ignorance of the subject he is trying to handle; and the average reporter is just as bad. For instance, "The captain struck eight bells and the huge liner backed out from the dock, 'full draft astern.'" Wonderful! "Eight bells" must always be struck, regardless of time, and by the captain, before the ship is in condition to move. Ain't it awful? And then to go back to the license law. The Chronicle says: "Stationary engineers." "No legislation whatever is required in regard to them." "Whoever hears of the explosion of one of these simple steam boilers such as are used for ordinary hoisting and the like?" The boiler of a logging engine exploded, according to this same paper only a few days ago, resulting, if I remember right, in the death of five or six persons.

Mere trifle—plenty more engineers. Some few years ago the boiler of a hoisting engine exploded on Howard-street wharf. Now listen to this: I know whereof I speak. This boiler was fitted with a safety valve. (The "Chronicle" chuckles considerably over the fact that all these boilers are fitted with a safety valve). This boiler was also fitted with a steam gauge, which registered a pressure of 20 lbs. just previous to the explosion. The engine was not in operation—the engineer was putting it on the blocks and two men were boring holes in the dock to receive the holding down bolts, dock screws as they are called; preparatory to going to work at 1 o'clock. This beastly boiler, without any warning, and at this inopportune time, exploded, killing one man outright and breaking both the engineer's legs. The boiler itself went clean over the topsail yard and landed upon the ballast in the ship's hold, carrying away the main stay in its descent. In this case either the much lauded safety valve or the steam gauge or both were out of order. I suppose this then was an act of God. Poor God, he has a whole lot to answer for.

Some few years ago, and not many at that, the boiler of a hoisting engine on a barge at the Grangers' warehouse at Crockett, exploded at about 12:45 p. m. The barge was made fast outside the ship and they were loading grain. In this case no one was hurt, because no one was on the barge at the time. The engineer was just about to go over the ship's side, in fact, his feet were upon the extreme top step of the ladder. The force of the explosion sank the barge and the boiler came down through the roof of the warehouse and landed on a pile of grain. This boiler, as usual, also had a safety valve. The engineer went crazy and died in an asylum. But, again, this is a mere trifle—plenty more engineers and plenty of work for the shops.

But, to again quote one of the ridiculous assertions made by the writer in the "Chronicle": "It is improbable that in one of these boilers sufficient steam could possibly be generated to cause an explosion." Let us see as to this. The boiler of an ordinary hoisting engine, donkey engine as it is usually called, is about 3 ft. in diameter and 6 ft. high. The pressure usually carried being 125 lbs. per square inch. A very simple calculation, which, even I can make, will show that the total pressure on the shell of this boiler under these conditions is 454 long tons. Also a mere trifle and not sufficient to do any damage to speak of. It may be pertinent here to ask, however, what is the horsepower of a donkey engine? Says the "Chronicle": "Employers do not wish their boilers to blow up and can be relied on to place no incompetent person in charge of them." This is rot. Every man who says he is an engineer is one and remains one until the disaster takes place. His competency cannot be determined at the start. When the thing happens and his competency has been passed upon, the employer says "who'd a' thought it?" This effort of the brain usually being followed by heavy damage suits, which are not trifles from the employer's point of view. The engineers have tried to benefit themselves as well as their employers and have been turned down. Fortunately, the undertaking business is not entirely a lost art.

Not very many moons since a man was scalded to death in the engine room of the "Chronicle" under peculiarly distressing circumstances, though no fault of of his, the accident being one entirely to faulty arrangements. It looks to me as though a boiler inspector would be the proper caper, especially in densely populated districts. I may say here that the engineers as a class have been trying to educate themselves to be better men and more useful members of the community for the past 30 years. If they had spent about 75 per cent of this time in educating the employer, everyone would now perhaps be better off. They commenced at the wrong end.

ASININITY VS. ABSURDITY.

A little further digest of "A Knave or a Fool" illustration in the Journal of Electricity for Feb. 25th produces a few interesting deductions not mentioned, and tending to enhance the condition of idiocy. To practice an experiment of this nature in a foreign location would be paradoxical enough, to practice it in one's native State shows mental ailment. Presume, with a disregard of illiteracy and fabrication, that this applicant had been employed as an electrical engineer, without recourse to his voluminous references, how long could he have carried out the hypocrisy, how long would he have been in evidence? The ultimate attainment from a proceeding of this character is less than nothing, if such can be reached; nothing might leave at least a good name, here, even this is forfeited, he is known as an impostor, and such an individual, in the most menial position, is not eligible to a reputable business. By an exhibition of asininity in a personified form the man literally kills any business association possibility. The Journal of Electricity is to be commended in its efforts to proclaim such fraud among the profession.

The writer was attracted a few weeks ago by the following "Help Wanted" advertisement, which appeared in a Pacific Coast periodical. Upon perusal the absurdity is manifest.

WANTED—Young assistant for field and office work: civil engineer with knowledge of geology; must be technically educated, rapid worker, but careful, exact and methodical: good observer; experienced in typewriting; good business head: good at map drafting, lettering and note taking; good habits, good walker, good appearance; experienced in meeting business men.

Here is a desire to obtain a 100-point man, the combination of an engineer and business man, embodied in a "young assistant." The essentials requisite appear formidable, even tending to the personal; "good" is used no less than six times, and it is assumed that perfection must be apparent in the qualifications not so prefixed.

The man who could honestly fill this bill must be a little more experienced and a little above the appellation "young assistant"; in truth, the engineer who could so act is hardly looking for a position, unless there is something radically wrong. This is asking for the impossible, and is tending towards absurdity.

If the desire had been for an electrical man the applicant given publicity in the Journal of Electricity might have filled the bill. A. J. R.

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POWER AND GAS

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NOTICE TO ADVERTISERS
Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Fuel Oil

When oil was first produced in commercial quantities in California coal users saw its possibilities as a cheap fuel provided that the supply was dependable and their furnaces could be adapted to its use. These doubts have long since been removed from the minds of the operators of industrial plants, locomotives and steamships, but there are still timid investors who hesitate to lend their assistance to industrial development dependent upon fuel oil. It is to such doubting Thomases that we commend a careful reading of the papers presented at the San Francisco meeting of the American Society of Mechanical Engineers.

As to the all important question of oil supply, Mr. Arthur F. L. Bell gives a conservative analysis of facts and figures from which the layman may readily disprove the bugaboo of oil failure. A calculation of the known and producing oil sands show that we have little to fear and that we may proceed with the development of our industries with the same confidence that the New Yorker feels in his fuel supply for the next year.

Coal furnaces have been satisfactorily adapted to oil burning, but there yet remains the popular fallacy disproved in Mr. A. M. Hunt's paper It was long held as obvious that the brightest flame was the most efficient, apparently giving off the most heat. In this paper it is shown with such a flame much fuel passes out of the stack unconsumed, whereas a red and smoky flame receiving a proper air supply, gives off the most heat. Many firemen have undoubtedly discovered this feature and profited thereby, but there are certainly many more who should educate themselves to this practice.

The further statement is made that the burner has less to do with the economic use of fuel oil than the form and design of the furnace. Scores of oil burners which have been developed represent a tremendous waste of inventive genius. How often does the enthusiast guarantee his burner as a panacea for all furnace troubles! While it is true that the burner must produce a spray of proper form and fineness under good control, the best results cannot be expected without a furnace suited to the conditions of each installation. This requires a technical knowledge of high order and is a fruitful field for further study in perfecting this branch of the art. The most needed burner improvement is some method for reducing the high cost of forcing oil through the burner, which now represents an outlay of about four per cent of the boiler power. Such papers and discussions as presented at this meeting are one of the best means of focusing competent attention on the problems to be met and bringing about needed improvements.

PERSONALS.

T. C. Ryland, of the Ryland Corporation of San Jose, was a recent San Francisco visitor.

C. L. Cory returned to his San Francisco office last Friday after a trip to Los Angeles on engineering business.

Thomas D. Campbell, general manager of the street railway system in Grand Forks, South Dakota, is a San Francisco visitor.

S. T. Wellman, president, and F. H. Bostwick, western manager of the Wellman-Seaver Morgan Company, are at San Francisco.

R. C. Gillis, president of the Mount Hood Railway & Power Company of Portland, has been spending a few days at San Francisco.

J. W. White, sales engineer of the San Francisco branch of the Fort Wayne Electric Works, left for Los Angeles during the past week.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, returned to Milwaukee last week after making a tour of the Pacific Coast.

Sidney Sprout returned to San Francisco last Wednesday, after spending several days at Sebastopol, Sonoma County on electrical engineering work.

E. L. Haines, one of the electrical engineers connected with the Pacific Coast branch of J. G. White & Co., left for the Eastern States last Sunday to recuperate after his recent illness.

F. O. Sievers and J. A. Herr of the sales departments of the Fort Wayne Electric Works and the Sprague Electric Company, respectively, spent the past week in the San Joaquin Valley.

Julian Adams has been appointed engineer in charge of power supply and electric distribution for the Pacific Electric Railway and the Los Angeles-Pacific Company of Los Angeles, Cal.

R. W. Van Norden has returned from an examination of the new Coleman plant of the Northern California Power Company in Shasta County, which is being erected in accordance with his designs.

Arthur Caldwell, who was formerly an engineer with the Pacific Telephone & Telegraph Company at San Francisco, has become manager of the California Electrical Construction Company of San Jose.

William F. Smith has been appointed engineer in charge of substations and overhead maintenance of way for the Pacific Electric Railway and the Los Angeles-Pacific Company of Los Angeles, Cal.

George R. Field, assistant general manager of the Great Western Power Company, recently returned to his San Francisco office after an inspection trip over the hydroelectric transmission system.

W. W. S. Butler, manager of the Western States Gas & Electric Company, one of the H. M. Byllesby corporations, with headquarters at Stockton, was a San Francisco visitor during the past week.

William Hoopes, the electrical engineer of the Aluminum Company of America, arrived at San Francisco last Thursday after a tour of the Pacific Northwest and made his headquarters with Pierson, Roeding & Co.

E. V. D. Johnson, general manager of the Northern California Power Company, has returned to his headquarters at Redding after spending a few days at the San Francisco office of the corporation in conference with President H. H. Noble.

R. D. Holabird, president of the Holabird-Reynolds Company returned to San Francisco last week, after an extensive Eastern tour. Mr. Holabird attended the conventions of the electrical jobbers and visited a number of the manufacturing plants.

L. E. Ashbaugh, one of the hydraulic engineers attached to the San Francisco office of J. G. White & Co., will soon leave for London for an assignment with J. G. White & Co., Ld., on a Brazilian hydroelectric project. He spent some time in Brazil last year in connection with an engineering enterprise.

F. H. Reed, first vice-president of J. G. White & Co., who is in charge of the company's financing, is spending a few days at the San Francisco branch office. Several years ago Mr. Reed financed the Manila Railway & Light Company, operated by J. G. White & Co., and the Philippine railways, but this is his first visit to California.

Frank D. Beal has opened offices as consulting wood preserving engineer in the Central Building, Seattle, Wash. Mr. Beal was with the Southern Pacific's wood preserving department for eighteen years, resigning as superintendent of their West Oakland creosoting plant in 1906 to take up similar work in Washington.

Colonel Frank H. Ray of New York, arrived at San Francisco last week and later proceeded to Medford, Ore, where preparations are on foot for extensions of the Rogue River Electric Co. The company is in the market for one or two additional 5000 kw. generators for installation at the present hydroelectric plant. It is understood that during the coming year work will be commenced on a new power plant, 30 miles farther up the Rogue River, which will cost about one million dollars.

Frederick S. Pearson of New York, who has been connected with the construction of a number of electric power, light and railway plants in North and South America, spent a few days at San Francisco on his way to Mexico with a party of capitalists. Dr. Pearson is at the head of the tramway companies of Rio Janeiro and the City of Mexico and of the light and power companies of the latter city. He is also president of the North Western Mexican Railway. C. H. Kearney and F. H. Huntriss of Rio Janeiro, Walter Gow of Toronto, V. A. Webenberg of New York, and F. Blackmon and Theodore Hubbard of London are in the party on the way to inspect their Mexican properties.

MEETING NOTICES.

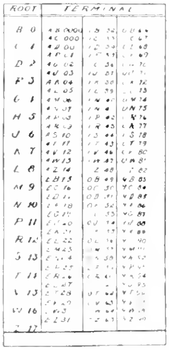
The Los Angeles Section of the American Institute of Electrical Engineers will discuss "Uniform Specifications for High Tension Line Crossings" at the meeting of March 28th to be held in Blanchard Hall, 231 South Broadway, at 8 p. m.

The March meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held in the Home Telephone Company's building at 333 Grant avenue, 8 p. m. March 24th. Prof. E. G. Cottrell of the University of California will speak on the "Electric Precipitation of Smelter Fume."

The Oregon Society of Engineers was organized at Portland last month with a charter membership of 160, D. C. Henny, consulting engineer of the U. S. Reclamation Service, being elected president; O. B. Coldwell, general superintendent of the power department of the Portland Railway, Light & Power Company, first vice-president; W. R. King, consulting hydraulic engineer, second vice-president; William H. Corbett (deceased), president of the Willamette Iron & Steel Works, third vice-president; C. E. Bliven, secretary; F. A. Naramore, assistant engineer of the Northwest Bridge Company, treasurer; Thomas Bilyeu, J. H. Norton and M. Quimby, one-year term directors; H. E. Plummer, A. D. Monteith and B. Honeyman, two-year term directors, and Ralph Budd, Frederick Powell and E. P. Rawson, three-year term directors.

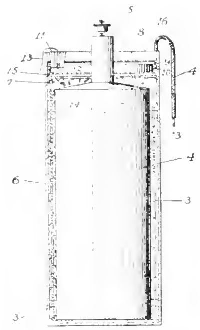
PATENTS

986,400. Telegraphic Code Concentrator. Charles Wood McDonald, San Francisco, Cal., assignor to International Keycode Company, San Francisco, Cal. In a cipher code, the combination with a sheet divided in any suitable manner into a root part and a terminal part, the root part consisting of a series of single consonants and their appropriate numbers, and the terminal part of a series of two letter syllables beginning with a vowel and ending with a consonant and their



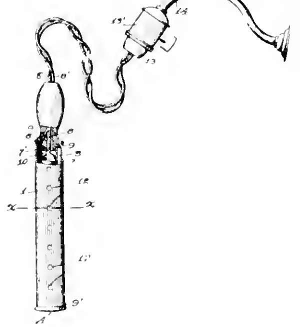
appropriate numbers, of sheets designated by vowels and showing series of two letter syllables beginning with a vowel and ending in a consonant, every syllable having appropriated thereto a series of numbers, whereby the contiguity of two consonants signifies the separation of two groups of numbers, the contiguity of a vowel and a consonant signifies their non-separation, and the contiguity of two vowels signifies a transfer to the sheets carrying said serial numbers.

986,064. Electric Battery. Carl Jaeger, Seattle, Wash. In a cell of a dry battery, in combination with the case, a closure for said case comprising a liquid holder of a destructible nature formed with an opening, a covering seal for said



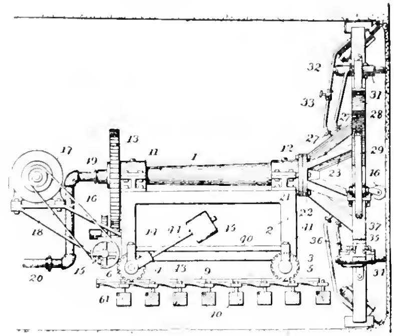
closure, a cork seated in the opening of said closure and projecting through the seal thereof, said cork being formed with a passage-way, a stopper in the passage-way of said cork, and a flexible puller attached to said stopper.

986,037. Electric Water-Heater. Abraham Albert, San Francisco, Cal., assignor, by mesne assignments, to Monarch Manufacturing and Supply Company. An electrical water heater, the same comprising an insulated handle provided with passage-ways for the current wires, an outer cylindrical perforated electrode secured thereto, an inner cylindrical perforated electrode fitted within the outer electrode and secured to said handle to leave an annular water circulating space between the electrodes, an insulated connection between the



lower ends of the said electrodes for holding the same spaced at such portion, current supply wires extended through the insulated handle and connected one to each electrode, and means for connecting the said wires to a source of electrical supply.

986,293. Tunneling and Shaft-Boring Machine. Franklin M. Iler, Denver, Colo. In a rock drilling machine, the combination with a suitable frame, of a hollow rotatable shaft carried by said frame, divergent rigid hollow arms constituting



a continuation of said hollow shaft and projecting therefrom at an angle, means for supporting fluid operated drills by said arms in various adjusted positions at different points, and means for connecting the inlet ports of said drills with the interior of said arms.

985,781. Process of Manufacturing Nitrate Fertilizers. Emil Collett and Moritz Eckardt, Christiania, Norway. The process of converting calcium cyanamid into nitrate of lime which consists in decomposing calcium cyanamid to produce ammonia, transforming the ammonia into nitrogen oxids or nitric acid, dissolving the residuum in the nitrogen oxids or nitric acid thereby obtaining a product containing nitrate of lime, all the nitrogen and all the lime contained in the original cyanamid.

NEWS NOTES

FINANCIAL.

CLAYTON, N. M.—Town of Clayton has voted $60,000 in bonds for a municipal water plant and system.

SAN DIEGO, CAL.—Sealed bids will be received up till March 27th for 340 water bonds valued at $1000 each.

BELLINGHAM, WASH.—Residents of Mountain View have subscribed $10,000 toward the construction of the proposed Nooksack interurban railway.

COLUMBUS, MONT.—It is understood that the electric railway line from Columbus to Cook City has been financed and that work will start when spring opens.

GRESHAM, ORE.—Bids will be received by D. Roberts, Recorder of Gresham, until the 4th of April for the whole or any part of $20,000 of the water bonds of the town of Gresham.

PASCO, WASH.—This place has rejected the proposition of the Pasco Reclamation Company to supply the city with irrigating water for the sum of $50,000. The majority of the people were in favor of the city purchasing its own plant.

CORVALLIS, WASH.—The Corvallis & Alsea River Railway, a logging line running from this place to Munroe, has been sold to the Portland, Eugene & Eastern Railway. The latter company announces that the newly purchased line will be electrified and extensions made.

GRESHAM, ORE.—Bids will be received by D. M. Roberts, Recorder of this place, up to April 4th for the purchase of $20,000 bonds. The sum of $15,000 of said bonds to be expended on the construction of a general water-works and system, and $5000 for the construction of a sewer and drainage system.

ORLAND, CAL.—To vote bonds for the sum of $50,000 for the installation of a municipal water and sewer system, the Board of City Trustees has called an election on May 2. One-half of the proposed bond issue will be devoted to the purpose of a water system and the balance of $25,000 to the construction of a sewer system.

WILLOWS, CAL.—The City Trustees at their last meeting decided to award the $40,000 bond issue, recently voted for the purpose of erecting a city hall, buying a hall site and purchasing fire apparatus, to E. H. Rollins & Co., of San Francisco, who offered $41,972. Other bidders and their bids were: J. H. Adams & Co., of San Francisco, $41,751; First National Bank of Willows, $41,512, and G. H. Baymyer of San Francisco, $40,870.50.

INCORPORATIONS.

LOS ANGELES, CAL.—Indian Hill Water Company of Pomona, $12,000, subscribed $125, by J. McKee, A. W. Richards, J. F. Cumberland, B. C. Strattan and S. Brubaker.

LOS ANGELES, CAL.—Rowland & Forster Water Company No. 1; capital stock, $25,000. Directors: W. R. Rowland, T. Del Valle, A. W. Ryan, T. W. Okey, George E. Cross.

SAN FRANCISCO, CAL.—Oro Electric Corporation, $10,000,000, shares $100 each, subscribed $700, by F. V. Pering, F. S. McAllister, W. B. Phelps, W. S. Wilsey, A. Harvey, E. Buchholz and W. G. Jack, 1 share each; place of business, San Francisco.

SAN BERNARDINO, CAL.—Articles of incorporation have been filed for the Jurupa Water Company. Capital stock is placed at $150,000. The incorporators are Arthur Wright, George H. Ennis, Frank H Brooks, Marie Bohlander and Louis Boehler.

MARTINEZ, CAL.—Bay Point Light & Water Company, $25,000, shares $100 each, by Scott Hendricks, G. S. Arnold, Grant Smith, F. A. Warner and A. E. Fisks of San Francisco.

ILLUMINATION.

PASADENA, CAL.—An extension of the gas mains of the Los Angeles Gas & Electric Company will be made to Altadena.

YREKA, CAL.—Sealed bids are being received by the clerk of the Board of Supervisors for supplying electric light fixtures for the new hall of records.

SPOKANE, WASH.—Walter Bryant will develop the power at Boulder Falls, three miles below Orient, and put in an electric plant to supply lights for the town.

BAKER CITY, ORE.—The city engineer has been authorized to prepare plans and estimates for a pipe line from Ely Creek to Salmon Creek in the plan of a municipal electric lighting plant.

OLYMPIA, WASH.—Bids will be received by the State Board of Control until March 20 for an electrical generating set to be installed in Western Washington Hospital for the Insane at Fort Steilacoom, near Tacoma.

WILLOWS, CAL.—E. V. D. Johnson of Redding, manager of the Northern California Power Company, states that the contracts have been let for the construction of a new gas plant here, and that all work will be commenced by May 15.

WASHINGTON, D. C.—Many of the public land States are underlain with petroleum deposits; natural gas also is a frequent associate resource. The Geological Survey estimate reported two years ago to the National Conservation Commission of the oil contained in the California deposits alone places the figure as high as 8,500,000,000 barrels, although this is admittedly conservative. Careful geological examination has been made of the Western oil fields, and public oil land withdrawals now aggregate 3,796,572 acres in California, Oregon, Wyoming, Utah, New Mexico, Colorado and Louisiana. These withdrawls are made in aid of proposed legislation, the present gold-placer law under which oil or gas land must be acquired being absurdly inadequate and also providing no means for the Government to retain an oil supply for the Navy, in which every new ship is now equipped with oil-burning furnaces.

TRANSMISSION.

VALDEZ, ALASKA.—The management of the Alaska Water, Light & Telephone Company announces that a new transmission line and other improvements will be made to the plant this summer. The voltage will be increased from 2300 to 13,000.

JORDAN, CAL.—A snowslide destroyed the plant of the Hydroelectric Company at this place on March 7, killing 10 people and depriving a number of nearby mining camps of power. The power plant of the Crystal Mining Company near Bodie was also swept away in like manner.

BAKER CITY, ORE.—The matter of building a pipe line from Salmon Creek to Elk Creek has been taken up by the City Council and the city engineer has been ordered to prepare estimates of the cost of constructing a power house on the site, as well as the cost of an additional storage reservoir of 3,000,000 gallons capacity.

MILTON, ORE.—City Electrician Coyle is extending the city's power service into the fruit districts, the farmers using it for pumping purposes.

LE GRANDE, CAL.—Price & Parrott, San Joaquin Light & Power men have been in town making preliminary arrangements for the companys proposed power line between this place and Plainsburg.

SPOKANE, WASH.—Assurance that the Panhandle Electric Railway & Power Company will erect a $2,000,000 plant and transmission line to bring power from Priest River to Spokane, and that the company will enter into active competition with the Washington Water Power Company has been made by A. J. Smith, agent of the new company.

MILTON, ORE.—City Electrician L. E. Coyle will commence work setting poles and stringing wires for two new power lines into the country north and west of Milton. The first line to be built at once, will be located north and west of Sunnyside while another is soon to be built on the east side of the Walla Walla River.

WILLOWS, CAL.—The officers of the recently formed Peoples Power Company are C. R. Wickes, president; D. A. Shellcoe, vice president; W. H. Travis, secretary. The company will obtain its electricity through the Sacramento Valley Power Company and will erect supply stations at Orland and in this city. These two stations will represent an outlay of about $20,000.

TELEPHONE AND TELEGRAPH.

LEWISTON, MONT.—The Rocky Mountain Bell Telephone Company is spending $26,000 on improvements to its line into this city.

LONG BEACH, CAL.—Plans for the installation of a wireless telegraph plant on top of Hotel Virginia are under consideration by the management.

VALE, ORE.—The City Council has granted a franchise to R. S. Johnson and associates for the construction of an independent telephone system in this city. A company will soon be incorporated.

LOS ANGELES, CAL.—Fire supposed to have been caused by crossed wires broke out March 3 in the Home Telephone Exchange building, 246 South Hill street, put out of commission 15,000 phones in the business section of the city, and damaged the building and electrical equipment to the extent of $27,000. The loss is covered by insurance. Chief Engineer Leo Keller of the company says he believed the approximate loss on equipment and building will total $26,500.

TRANSPORTATION.

VALLEJO, CAL.—The Vallejo & Northern Railroad has obtained from the Board of Trustees the right to enter the city of Vallejo, the franchise granted being along the water front of the city.

SALINAS, CAL.—F. G. Baum, chief engineer of the Monterey County Gas & Electric Company, has made application for a franchise for an electric line from Monterey along the Salinas road to Castroville, via Salinas.

SAN FRANCISCO, CAL.—The Supervisors have passed a bill authorizing the Board of Public Works to expend any necessary sum up to $60,000 for the purchase of special track material for the Geary street municipal railroad.

VICTORIA, B. C.—Construction work will start at once on the suburban electric railroad from this place through the center of the Saanich peninsula to the northern terminus, for the British Columbia Electric Company. The line will be 22 miles in length.

FRESNO, CAL.—The deed to be given by the Fresno, Hanford and Summit Lake Railroad Company as security for the bonds which are being issued by the Guaranty Trust Company of New York has been signed. Work on the proposed interurban line will start at once, actual construction work starting near Lone Star.

SAN FRANCISCO, CAL.—The Board of Public Works has called for bids for the tubular steel poles and the redwood crossties for the municipal Geary road to be received March 22. No bids have been received for the latter on the board's first call, the ties being in great demand and the supply in sight for the market not equal to the requirements.

OAKLAND, CAL.—The Southern Pacific has submitted a plan which met with the favor of the City Council and an ordinance granting the railroad a franchise on Seventh street was passed to print by a unanimous vote. This ordinance provides for a 35-year term, a payment to the city of $5000 annually for the first 15 years and thereafter $8500 per annum; the paving of Seventh street at a cost of $200,000, and the lighting of the street at a cost of approximately $9000 per year.

WATERWORKS.

MOUNTAIN HOME, CAL.—An election will be held next week to vote on the question of issuing bonds for municipal water-works.

TRACY, CAL.—An application has been made by the Tracy Water-works Company for a franchise to lay pipes and operate a water system in this city.

BELLINGHAM, WASH.—The Keystone Meter Company presented the lowest bid for supplying the city with water meters, but the award has not yet been made.

ESCONDIDO, CAL.—A movement is on foot for the improvement of the city water system, the City Trustees having appointed a committee to report on the matter.

ASTORIA, ORE.—Bids will be received by the water commission up to March 31 for constructing a gate valve and laying 14,000 feet of iron pipe, 6, 8, 10, 12 and 18 inch, for the city. Check for 5 per cent of amount of bid required.

VALLEJO, CAL.—The City Clerk has been authorized to call for proposals for the laying of the 14-inch pipe line from Fleming Hill to Georgia street and 8-inch main from Georgia street to Fourth street, South Vallejo. Bids will be opened on April 3, 1911.

ASTORIA, ORE.—Palmberg & Matson have awarded a contract to the Wood Pipe Company of Portland for furnishing about 140 tons of steel bands to be used in the construction of the main conduit of the water system. They have also awarded a contract to Ness & Martin, of Portland, to furnish the connections and other castings required for the work.

BAKERSFIELD, CAL.—Fairbanks-Morse & Co. was awarded the contract for a 13 horsepower Jackson centrifugal pump for the High School Agricultural Farm for $675, The Western Gas Engine Company bid $670.10 for a 12 horsepower pump. The Pioneer Mercantile Company $922 for one of 15 horsepower and Ardizzi-Olcesse Company, $860, for one of 12 horsepower.

OCEANSIDE, CAL.—The United States Pipe Company of San Francisco has been awarded a contract for supplying pipe and fittings for extensions to be made to the city water system. Bids were for pipe, $34.15 per ton and for fittings, $62 per ton; total of contract $11,000. The City Clerk has been instructed to advertise for bids for digging ditches and laying mains.

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ELECTRICAL EQUIPMENT OF HOTEL ST. FRANCIS

BY G. A. SCHNEIDER

Not least of the factors which contribute to San Francisco's reputation for hospitality are its numerous hotels, of which the St. Francis is the largest and perhaps the most completely equipped with those appointments which promote the comfort of its guests. Facing the beautiful Union Square, which is the theatre for the principal events of all the famous festivals of San Francisco, this hotel occupies a most appropriate position for an institution of its kind.

The Hotel St. Francis stands on the northwest corner of Geary and Powell streets, in the heart of the fashionable theatres, clubs and shops of the city. From an architectural point of view it adds much to the ever increasing number of magnificent buildings in this vicinity.

It is thirteen stories in height above the street level, with one story below and contains 720 guest rooms, not including the recently completed annex on the Geary street side. Another annex to be built just north of the present structure will bring the total of rooms to 1046 and give a capacity about equal to any hotel in existence.

The exterior of the building is gracefully proportioned and is finished in such a manner as to be especially pleasing. The interior finishing and furnishing are in keeping with the beautiful exterior and from an engineering standpoint, the heating, lighting and numerous power applications are in accordance with the most modern practice.

Hotel St. Francis, San Francisco.

When originally constructed the hotel was provided with a power equipment suitable for all service other than furnishing the electrical energy required. In the spring of 1909, the management considered the installation of its own electric plant and after careful investigation the advantages to be derived therefrom secured its adoption. The plant now completed has a total capacity of 825 kilo-watts.

Due to the limited amount of space available for this new equipment, the arrangement is not as good as it might be under more favorable conditions. This, however, does not detract from the high quality of the apparatus and the careful and thorough manner in which it has been installed. The plant can, therefore, be expected to give good results and should prove an excellent investment.

The new boiler and engine room is placed under

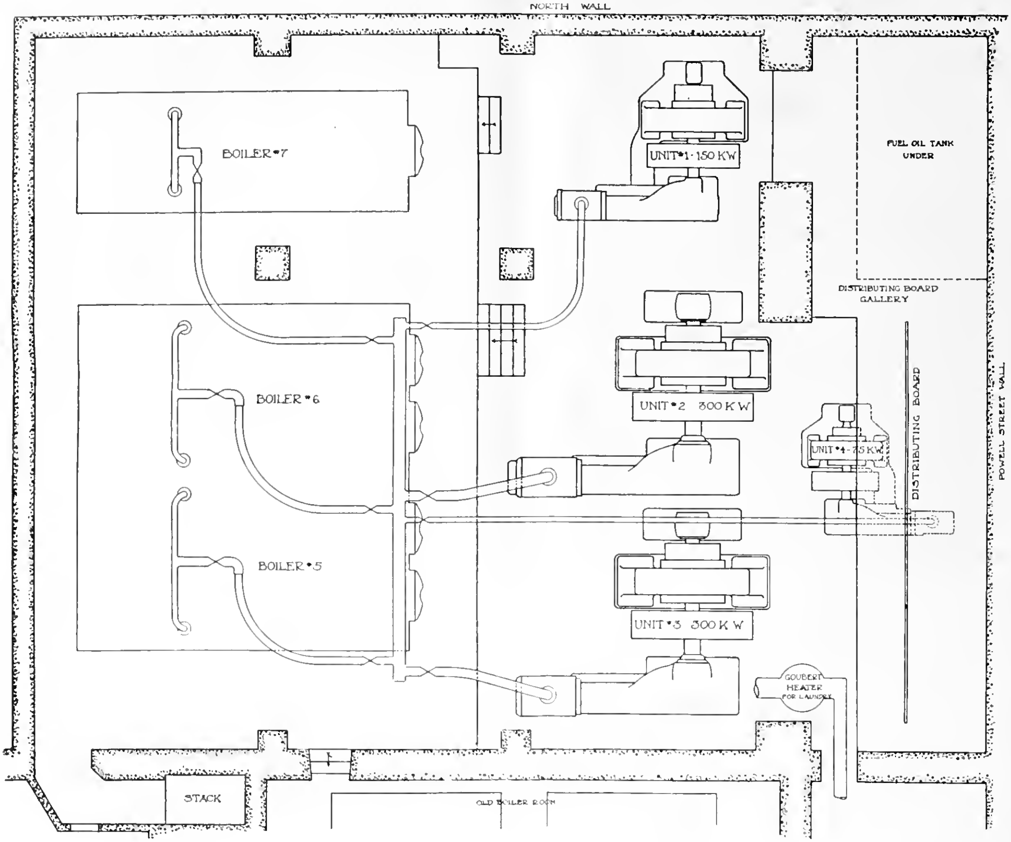


Fig. 1. General Plan of Engine and Boiler Room.

the north wing of the hotel and extends beyond the Powell street wall, a distance of 12 ft. under the sidewalk. The room is about 50 ft. wide and 67 ft. deep The relative position of the generating units and boilers is shown in Fig. 1 which was reproduced in part from the original floor plan, while Fig. 2 illustrates one corner of the room.

Boilers.

The boiler equipment comprises three Babcock & Wilcox water-tube boilers, having a combined capacity of 858 h.p.—with two boilers set in one bank and the other singly. The boilers are set on a level about 4 ft. below the engine floor to allow sufficient head room. Each boiler is provided with a Little Giant oil burner, California crude oil being used entirely for fuel. Suitable oil and steam supply pipes from pumps in the old boiler room (to be described later) are brought to these burners, all of which are controlled by valves conveniently placed. Steam is maintained at 140 lb. per square in.

The stack extends up through the center of the building 25 ft. above the roof. It is about 6 ft. in diameter and is connected to the boilers by breeching extending along the rear wall.

Oil for the boilers is stored in two tanks, each holding 8000 gallons. One of these is under the floor of the new engine room and the other under the old boiler room. The entire supply is delivered into the first tank from which it is pumped into the second tank as used. This scheme of handling was devised to overcome the necessity of having tank wagons stop directly in front of the hotel main entrance to deliver oil.

Piping.

The steam piping consists of a 10-in. main header placed just over the front of the boilers, to which lines are connected from each boiler. These connections make a ninety degree bend and are placed in a horizontal position. From this steam-header connections are made to each engine. There is also a connection leading to the old boiler room enabling all boilers to work in parallel.

Each engine has a separate steam separator mounted just over the throttle valve and each separator is individually connected to a Denny steam trap. The steam lines from separators to trap are kept open at all times, thus insuring dry steam at the throttle. A trap of the same type is also supplied for the main

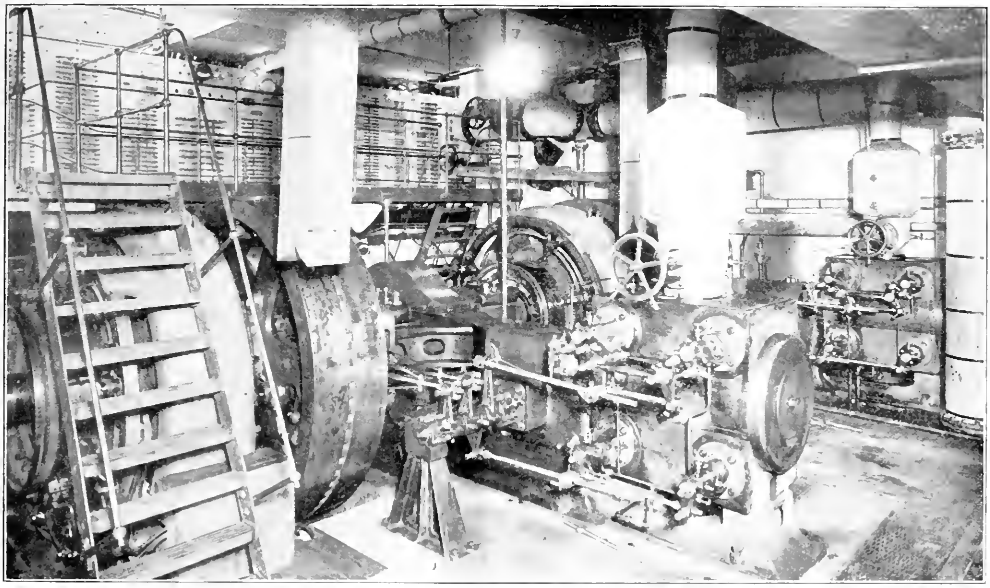


Fig. 2. General View of Engine Room.

steam header. These traps are all mounted upon the wall just to the right of the exhaust steam riser.

All engines discharge into a common 16 in. exhaust main, laid in a floor trench, which is provided with an iron cover. This main extends to the south wall, when it rises, then passes along the wall to a large oil separator, from which it continues to a Goubert heater, used for furnishing hot water to the laundry. A by-pass around this heater is extended directly into two 1200 h.p. Cochrane feed water heaters, near the Powell street wall in the old boiler room. From these heaters and other steam devices throughout the building, exhaust steam is discharged into the atmosphere by an exhaust main leading to the roof and running along side of the chimney. The exhaust steam main, laundry heater and bypass valve, as well as the separators at the engine throttles are clearly shown in Fig. 2. The small pipe shown in this same figure as passing over the distributing board supplies steam to the 75 kw. set under the gallery. All high pressure steam piping is of extra heavy wrought iron with heavy rolled steel flanges, but the exhaust steam lines are of standard wrought iron with regular cast iron fittings. The feed water mains and other high pressure pipes in sizes smaller than 5 in. are of wrought iron with standard fittings. The entire high pressure piping system was subjected to a hydrostatic test of 240 lb. after being erected. Both live steam and exhaust mains are carefully covered with asbestos covering.

In Fig. 2 there is shown an iron stairway leading to an L-shaped platform which passes along the front of the gallery to the by-pass and valves of the Goubert heater. Due to the crowded condition of the room it was thought advisable to provide this means of passing over the units. This stairway also furnishes a means of exit from the room to the chief engineer's office and electrician's shop, since the gallery extends over the entire front part of the room—that is, under the Powell street sidewalk.

Engine and Boiler Room Ventilation.

Since the large tapestry room of the hotel is directly above the new power plant it was necessary to install a special ventilating system to prevent heating this room. This system of ventilation was carefully planned and installed by Henshaw, Bulkley & Company, who guaranteed to keep the floor of the engine room cool at all times and to limit the temperature of the boiler room to within 15 degrees Fahrenheit higher than the outside temperature.

For this purpose there is installed two double-width Union Blower and Engineering Company's 90 in. full housing fans, each direct connected to an 18 h.p. 365 r.p.m. 220 volt commutating pole direct current motor. At this speed these fans deliver 29,-400 cubic feet of air per minute, but each motor is provided with a speed regulator allowing the volume to vary according to the demand.

The air supply from the first fan is divided so that one-half is forced between the tapestry room floor and the boiler room ceiling, the rest is brought down through ducts terminating over each of the three larger units and discharging towards the boilers.

The second fan exhausts the warm air from the upper part of the room and over the boilers. Both fans are placed in two small rooms at the left of the 150 kw. set, but outside of the engine room. A separate room is provided for each fan. The fresh air intake ducts and also the exhaust duct terminate just outside of the north wall. This system of ventilation effectively accomplishes the purpose intended and no trouble from excessive heat is anticipated even during the hottest days.

Generators and Engines.

There are four generating units consisting of Harrisburg Fleming simple, non-condensing, four-valve engines direct connected to Western Electric Design "L" engine type generators of three different capacities. Two smaller units are rated at 75 and 150 kw. respectively and operate at 225 r.p.m. The two larger sets are each rated at 300 kw. at 150 r.p.m. The engines of the smaller units have their sub-base extended to support the generator, while the 300 kw. generators are provided with separate foundation plates set independent of the engine bases. The generators are three-wire compound wound machines designed for 125-250 volts at full load.

In general design and appearance these machines are similar to Western Electric standard two-wire generators of the same type; in fact, the resemblance is so close that many engineers who inspected this equipment have failed to notice the difference. Others have remarked that a three-wire, or double voltage generator, could not be built without the usual external balance coils. These facts cause the writer to believe that a brief explanation of the manner of deriving the neutral point for the system will be of interest.

The double voltage in these generators results from the use of a special balancing winding on the armature. The coils of this winding lie beneath the usual armature winding and at the bottom of the slot, which is made deeper for this purpose. This auxiliary, or compensating winding, is protected from damage, which might result from a burn-out of a coil in the main winding, by a practically fire-proof strip of insulation in addition to the ample insulation provided on the coils themselves. The section of copper in the auxiliary winding is liberal, thus keeping the current density low and enabling the machine to take care of large unbalanced loads without injury to any part The neutral points in the balancing winding are connected to a brass collector ring mounted on the commutator cap from which it is thoroughly insulated.

The brushes for this collector or neutral ring are mounted on an extension of one or more of the regular brush-holder studs, being insulated from them. The brushes are of metallic carbon which wears slowly and gives a good contact of low resistance. The neutral wire is connected to these brushes and the system is operated without external balancing coils or additional apparatus.

In order to compound for the total load on the generator the series winding is divided with respect to the armature; the coils on alternate poles being connected to the same side of the armature. As a result of this design, the liability of breaking down the insulation of the series coils is reduced to a minimum, since coils having the full potential of the machine between them are not placed on the same pole. This arrangement further results in perfectly balanced magnetic and electric circuits.

The balancing winding is designed for a 25 per cent unbalance; that is, to operate satisfactorily with 25 per cent of the normal full load current flowing in the neutral wire. Under these conditions of unbalance, the difference in voltage between the two sides of the system will not exceed 2 per cent of the total rated voltage of the system. In other words, when the neutral is carrying 25 per cent of normal full load current, the voltage between neutral and outside wire on the loaded side will not be less than 122.5 volts and on the unloaded side not more than 127.5 volts, which is a difference of 5 volts or 2 per cent of the total voltage.

The voltage regulation for the 150 kw. machine operated on unbalanced load, as shown by factory test, was as follows:

Gen. Volts.	Amp. Output	Speed	Volts Neutral to Pos.	Volts Neutral to Neg.	Neutral Current
230	0	229	115	115	0
230	0	229	112.5	117.5	150
230	0	229	110	120	310
250	600	225	125	125	0
250	600	225	123	127	146
250	600	225	120.5	129.5	330

These tests show that for unbalanced loads the difference of potential between the two sides of the system is practically proportional to the amount of unbalance even up to double neutral current. It will thus be seen that with the system fairly balanced the regulation will be satisfactory.

Due to the small space available for the switchboard apparatus, the equipment used in this installation is quite different from that found in the average isolated plant, or even central station, of corresponding capacity. Several different switchboards following conventional designs were planned, but after careful consideration were given up in favor of a remote control equipment which could be more readily adapted to the conditions. This selection was largely influenced by the small head room available under the gallery where the switchboard was to be placed.

Circuit Breakers.

Each generator is protected by an I-T-E (Cutter Company) motor-operated, laminated circuit breaker, controlled from a suitable panel some distance away. The open and closed positions of the breakers are shown by red and green indicating lamps located at the point of control.

The breakers are of the three-pole overload type, each pole having an independent trip coil, the outside pole coils having a carrying capacity equal to the corresponding generator current, while the middle pole for the neutral lead is designed for 25 per cent of full load current. The outside poles are also equipped with equalizer contacts and all poles, including equalizers, close or open together.

All breakers are mounted upon oiled-slate panels, arranged in one bank which is placed under the distributing board gallery just to the left of the 75 kw. set. The panels are supported by an extra heavy double angle iron frame which is securely braced from the rear wall and also bolted to channel irons set in the cement foundation. This construction is well illustrated in Fig. 3. Each slate panel is divided into two sections, the upper containing the breaker and the lower the motor and operating mechanism. This division is of great convenience in shipping and when the breakers are being installed. To the writer's knowledge this is the first installation of these breakers on

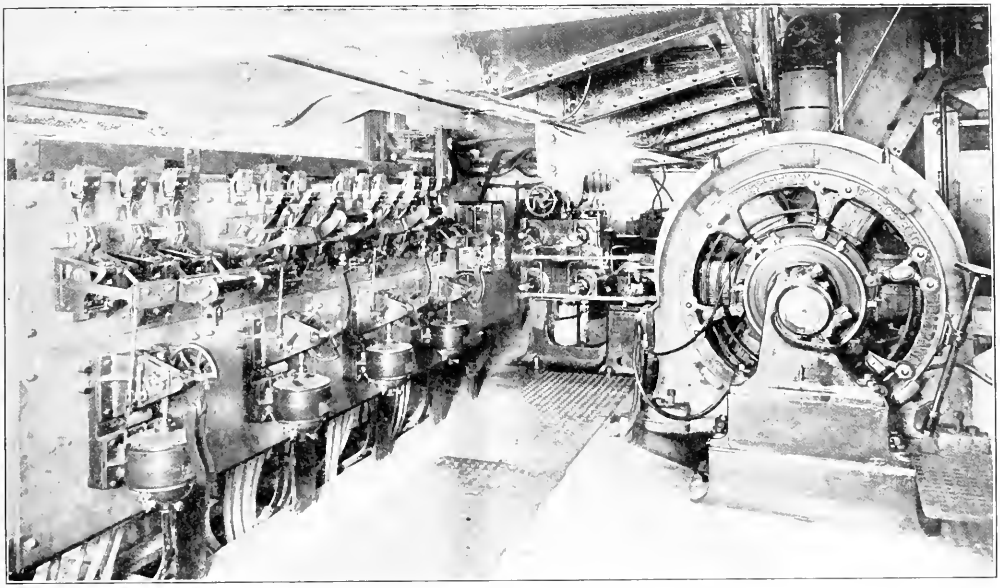


Fig. 3. Circuit Breaker Board and 75 kw. Units.

the Pacific Coast and as the operating mechanism is so cleverly designed, a detail description may be of interest.

The operation of these breakers will be understood by reference to Fig. 4 in which is shown diagramatically the essential working parts with the breaker in a closed position and the motor at rest. In closing the breaker, the movement of the motor is communicated to a gear sector A by means of a worm gear B connected by a ball and socket joint to an extension of the motor shaft; the gear sector is in turn connected by a link C to the breaker operating arm. During the act of closing, the worm B is forced into engagement with the gear sector by a magnet E connected in shunt with the motor fields. With the motor at rest, the worm is held out of mesh with the gear sector by means of the spring-actuated toggle D.

The motor movement and corresponding travel of the breaker operating arm is limited by the timing or limit switch, shown at F on the framework supporting the gear mechanism. This timing switch is automatically opened when the breaker is closed and closed when the breaker opens; the movements of the circuit breaker in both operations being transmitted to the switch by the vertical rod G.

With the breaker open and the timing switch in its corresponding closed position, the motor may be brought into the circuit from the control panel by means of an appropriate switch H, starting the motor through the resistance J. This resistance is short-circuited almost immediately by the action of the toggle D on the localizing switch I, which also connects the motor directly with the control circuit mains independent of the switch H.

The breaker is fully closed in about three-fifths of a second, at which time rod G operates switch F open-

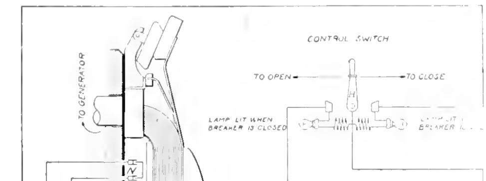


Fig. 4. Internal Connection of Circuit Breaker.

ing the motor and magnet circuits, thus throwing the worm out of mesh with the gear sector A.

Should abnormal current conditions exist, either in the outside mains or neutral, the breaker is ready to respond instantly to the action of the regular over-

load coils and open without restraint or drag from the motor operating mechanism.

At the instant of closing, the control switch H is cut into the circuit by the contact X, ready to open the circuit breaker. Throwing the switch H to the opening position trips the breaker through the medium of a coil T, which action again throws the switch F into closing position. Due to the localizing switch I, the operator has no means of control from the time the motor is started until the breaker is fully closed. Further, the operator at the control panel cannot close the breakers against overload. The operating motors are 250 volt series wound machines, rated 1/4 h.p. at 1650 r.p.m.

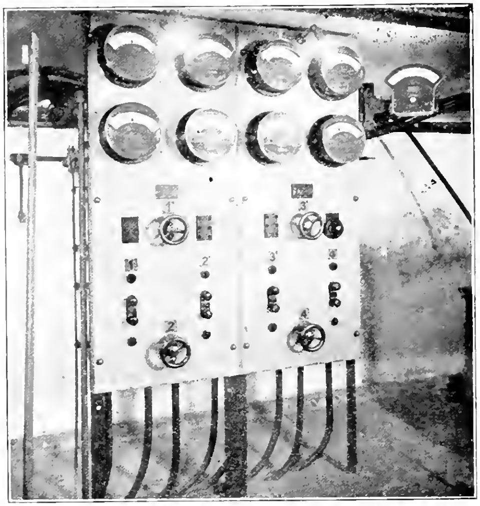


Fig. 5. Control Panels.

Control Panels.

As already explained, the breakers are entirely automatic in action and will respond instantly to overload even in the act of closing; hence, the usual hand switch in series with the generator leads is eliminated in this installation. The generators are connected directly to the circuit breakers by rubber insulated lead covered cables, laid in wooden lined troughs built in the cement foundation. These troughs are arranged to allow any particular cable being withdrawn without disturbing the others in the same trough. One trough is provided for the leads of each generator. The circuit breakers, including equalizer contacts, are connected directly to a single set of bus-bars, allowing any or all generators to be operated in parallel. These bus-bars are located directly back of the circuit breaker panels and supported by the same framework.

The circuit breakers are operated from two control panels, illustrated in Fig. 5, which are placed under the main distributing board gallery, just to the right of the 75 kw. unit. These panels are of blue Vermont marble, each 24 by 60 inches, mounted upon an angle iron frame braced from the rear wall.

Two Model 57 Weston ammeters, with scales of sufficient range to permit of about 50 per cent overload, one pull button control switch with red and green indicating lamps, one Ward Leonard field rheostat and a 6 point potential receptacle are provided for each generator circuit. The right hand panel contains an extra 6 point receptacle, also a Weston Model 9 illuminated dial voltmeter, scale 0-300, mounted on a swinging bracket.

The field rheostats are mounted upon an iron frame placed near the rear wall. Connections to the operating handles are made by one-half inch iron rods. This construction gives ample space at the rear of each panel to bring up conduits containing the various control wires without crowding. All control apparatus is placed in the same relative position as the corresponding breaker and generator controlled, which arrangement in addition to the number plates provided, tends to eliminate errors by the switchboard attendant.

Operation of the entire control apparatus will be readily understood by referring to Fig. 6 showing connections between the controlling apparatus and circuit breaker for one generator. Each unit is connected exactly in the same manner, hence a statement applying to one will cover all.

The internal connections of the circuit breaker in this diagram are identical as already shown in Fig. 4, except that the single pole knife switch indicated at H has been replaced by the pull button switch heretofore mentioned. Also the separate set of control mains shown has not been provided.

The control switches used are the twin pull button type made by the General Electric Company. In operation they perform the service of two separate single pole switches, but the parts are mounted in one piece. One button actuates the closing contacts and the other the opening contacts. The contacts are normally held open by a spiral spring, and the buttons are inter-locked mechanically so that it is impossible to operate both together.

Each switch is provided with an indicator which shows green after one button has been operated to open the circuit breaker, and red after the other button has been operated to close the breaker. The indicating lamps are connected to show the actual position of the circuit breaker, red when breaker is closed and green when it is open. These lamps are entirely independent of the pull switch indicator. Eight c.p., 140 volt clear tubular lamps with candelabra base, are used for this purpose. They are mounted in special receptacles, placed on the rear of panels.

While these lamps are usually described as red and green, they are actually clear lamps with receptacles provided with colored lenses on the front of the panel. The green lenses are placed above, and the red lenses below the pull switches. A V-shaped projection is cast on the front of the lenses to make the lamps plainly visible from a distance or when seen at an angle.

By tracing through the diagram it will be seen that the circuit containing operating motor and its accessories for closing the breaker is connected directly across the outside generator terminals, while the trip coil circuit is connected across the outside bus-bars. Each control circuit contains an indicating lamp and 500 ohm resistance unit, both of which are shunted by the contacts of the pull switch.

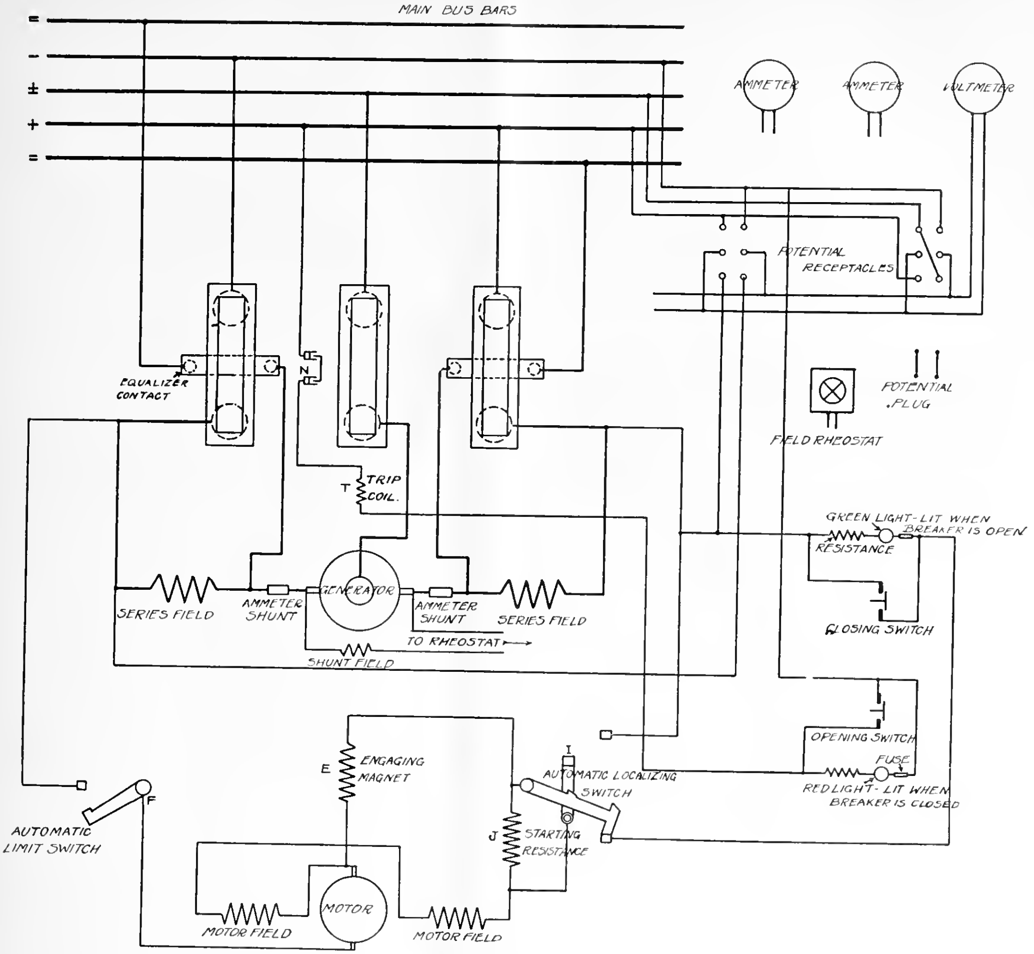


Fig. 6. Diagram of Connections for Generators, Circuit Breakers and Control Wiring.

With the foregoing explanation, the sequence of operations in starting a generator can be readily followed. First, having the corresponding circuit breaker open, the generator is brought up to normal speed—then with the potential plug in the lower position, the voltage is raised to its proper value, as indicated by the voltmeter. The green indicating lamp, which also acts as a pilot lamp during starting, will then be up to full candle power since it is in series with the closing circuit connected across the generator terminals. Thus a very small current will pass through the motor armature and fields and other parts of the control circuit, until the breaker is closed. Due to the low resistance of the motor, the difference of potential across its terminals is not sufficient to produce rotation, hence the motor remains at rest. The breaker is then closed by momentarily pulling the control switch button nearest the green lamp. This operation short circuits the lamp and resistance, placing the full generator potential across the motor terminals, causing it to quickly close the breaker. At the same time, the motor circuit is opened by the timing or limit switch, and the green lamp is extinguished. But the opening control circuit is now completed by the contact N, (Fig 4), hence the red lamp will burn at about normal brilliancy, although the amount of current flowing will not be sufficient to trip the breaker. The method of paralleling two or more generators does not require discussion, since the operation is the same for each unit. Fig. 5 shows the board when the 150 and 75 kw. units are running in parallel, both at full load. The ammeters show how well the lighting load is balanced.

The breaker may be opened by pulling the button nearest the red lamp, which action short circuits both resistance and lamp, allowing sufficient current in the circuit to operate the trip-coil T, or the breaker may open due to the action of its overload coils. Either operation will again light the green lamp, but if the pull switch indicator and indicating lamps do not agree in color the operator at once knows the circuit breaker has tripped automatically from overload. This feature could hardly be considered of real importance

Night Illumination of Hotel St. Francis

in this particular installation, as a breaker when opening would probably produce sufficient noise to attract the operator's attention. Further, the ammeters would immediately indicate the condition.

As already stated, the machine voltage is read by placing a potential plug in the lower position, while the upper position indicates the outer bus voltage. By means of the extra potential receptacle shown on the right in Fig. 6, the voltage between either main bus and the neutral can be read. The ammeters are connected directly to shunts mounted upon the generator head boards but for convenience the shunt leads are omitted in the diagram. Also the leads to field rheostat are not shown. For shunt leads No. 12 Habirshaw duplex rubber covered wire is used each ammeter with corresponding lead and shunt having been calibrated after length of lead required was obtained. Each control circuit is properly fused although not shown in the diagram. All control circuits, including field rheostat leads and ammeter shunt leads are wired in iron conduit with Crouse-Hinds Condulet terminals. For control circuits No. 12 Habirshaw rubber-covered wire is used, while the field leads are No. 10 wire.

Distributing Mains.

From the main bus bars, the current passes through a 3000 ampere, 250 volt, three-wire Duncan watthour meter, mounted on a panel placed at the right end of the circuit breaker bank. This meter is in turn connected by a set of three bus-bars (one each for the positive, main and neutral leads) to the lower clips of a 3000 ampere, triple pole, double throw Crouse-Hinds knife switch, mounted almost directly above the watthour meter on the distributing board gallery. The upper clips of this switch are connected directly to the

118-236 volt three-wire alternating current mains of the City Electric Company, who supplied the entire hotel before the installation of this plant.

This switch is used only for transfer purposes in emergency and is not intended to be opened under any considerable load, as the outside service just mentioned can be handled by oil switches placed in the transformer manholes just outside the rear wall. Operating rods for these switches are extended through to handles mounted upon the wall back of the distributing panels.

The distributing board, partly shown in Fig. 2, consists of 13 panels of Vermont blue marble, 84 in. high and 26 ft. long. Three of the end panels at the right control power circuits and other circuits that must always be supplied with direct current—the remaining ten panels control the various lighting circuits which may be operated from either direct or alternating current. The latter panels are supplied from a set of bus-bars connected to the middle points of the emergency switch so that the lighting circuits receive alternating current with the switch thrown to the upper position and direct current from the local plant when in its lower position.

To supply the power circuits the City Electric Company furnish 110-220 volt three-wire direct current service, which is also used in emergency. A 500 ampere, three-pole double throw fused switch mounted on a separate panel back of the main distributing board is provided, so that the three power panels may be supplied from the local generators or the outside service. This switch is connected to the lower lugs of the large transfer switch by three lead covered cables laid along the wall on the distributing board floor. This scheme of connections is shown in Fig. 7.

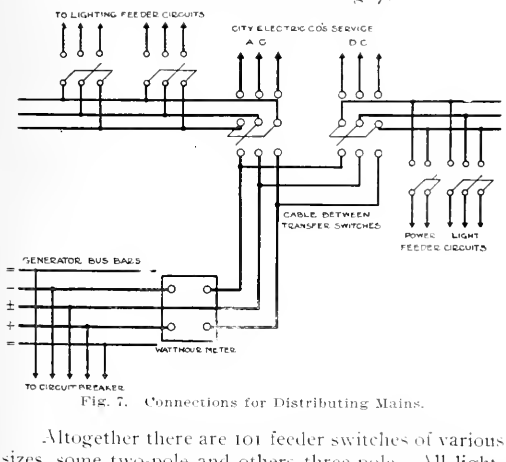


Fig. 7. Connections for Distributing Mains.

Altogether there are 101 feeder switches of various sizes, some two-pole and others three-pole. All lighting circuit switches are double throw with both sets of fuses connected to the same bus. This scheme enables the operator to transfer a circuit to good fuses without delay.

A Bristol recording ammeter and voltmeter is provided for each side of the system on the lighting panels. There is also a voltmeter with necessary potential plugs, enabling the voltage across either outside main and the neutral to be read. Both voltmeter and Bristol instruments will work on either direct or alternating current, so they are not injured when the system is transferred to outside service—although the accuracy is considerably affected.

The last power panel contains a Duncan watthour meter which records the energy used by the electric range in the men's grill room.

The entire distributing board, excepting the transfer switches was installed several years ago; hence, is not part of the new equipment. Leads from the distributing board are run in conduits to various distributing centers throughout the building in accordance with standard practice.

Original Boiler and Pump Rooms.

The old boiler room previously mentioned is situated just to the south of the new engine room. It extends from the Powell street wall back for a distance of about 45 ft., the rear wall coming about in line with the front of the new boilers. The room is about 32 ft. in width. Connection to the new room is made by a narrow passage way running between the rear wall and boilers.

The original boiler equipment consists of four Babcock and Wilcox boilers, each of 83 h.p., all connected to a common steam header now extended to the new boilers. This gives the plant a total of 1100 h.p. boiler capacity. These boilers are set in the usual manner and are equipped for burning oil.

Water for these boilers and the new ones as well is pumped from the Cochrane heaters by two 10x6x10 Snow duplex pumps. The old boiler room in addition contains numerous other pumps, heaters and water filters, to be described later.

Still further to the south there is another room in which are numerous water and vacuum pumps, an ice and refrigerating plant, ventilating apparatus, machinery for pneumatic tube system, vacuum cleaning plant and terminal room for telephone exchange, all of which will be covered briefly in the following paragraphs.

This room is in the shape of an L—one side being just opposite the front of the old boilers and the other side, extending just back of the boiler room rear wall. It is on a level with the main hotel basement, but about 8 ft. above the level of the old and new boiler rooms. A flight of cast iron stairs lead down to the old room in line with the passage to the new plant. It might further be stated at this point that all rooms have at least two entrances so that in case of emergency there would always be means of escape.

Water Supply.

The general water supply for the building is taken from the mains of the Spring Valley Water Company. The water first passes through four Jewell filters, each of about 1500 gallons capacity and then to a main supply tank in the old boiler room. From this tank the water is pumped into four house supply tanks on the roof having a combined capacity of 32,000 gallons. This pumping is done by two 10x6x10 Dow vertical duplex pumps and one 10x5x10 Worthington compound duplex pump.

Due to the large capacity of the house tanks, the hotel has a reliable source of water supply for

fire purposes. Throughout the building there are many hydrants or water plugs connected directly to these tanks by a separate system of mains. The valves for these mains are always open, keeping the hydrants ready for immediate use. Should the pressure from the tanks not be sufficient, the two vertical duplex pumps just mentioned can be instantly converted into high pressure fire pumps, taking their water supply direct from the city mains and pumping directly into the mains supplying the hydrants.

There are also two pumps used in supplying the baths on the twelfth floor. One a 6 x 4 x 6 duplex Worthington pump, supplies fresh water, the other a Smith Vaile pump of the same size handles the salt water supply which is taken directly from the mains of the Olympic Water Company, whose mains extend directly to a pumping station on the ocean beach.

Hot water for the entire building is supplied from three heaters near the old boilers. Ordinarily these heaters are operated from exhaust steam, but if this is not available, live steam is used. After passing from the heaters through the various mains the water discharges into a return header placed near the heaters. From this header the water is again pumped into the heater by a 6 x 4 x 6 Worthington duplex pump.

This system of circulating not only insures a uniform temperature throughout the mains but also is less severe on the plumbing fixtures since without the circulating pump the water must be kept at a high temperature to produce even fair circulation over such a large system and high temperature rapidly destroys the valves and pump packing.

Heating and Ventilating System.

In a hotel of this size, which is constantly occupied by from 800 to 1500 persons, an efficient system of ventilation is essential. For the ventilation of the dining rooms, cafe, main lobby and other large public rooms there is installed two 12 ft. Sturtevant fans each direct connected to a slow speed steam engine. One of these handles the fresh air supply and is equipped with an air washing device for cleaning or purifying the air supplied. This device further tends to keep the air supply cool at all times. A set of steam heating coils is also placed in the discharge duct of this fan, enabling it to supply warm air when necessary.

The ballroom is supplied by a separate system of ventilation much on the order of that just described. Two large blower fans operated by electric motors are supplied for this purpose. These fans are so designed that either may be used as a discharge or suction fan. One is placed in the basement and the other in the laundry on the fourteenth floor.

Normally the basement fan, also equipped with an air washing device and steam heating coils, is used to draw in fresh air which is discharged into the top of the ballroom. The laundry fan in turn removes the foul air through an air duct entering at the floor of the ballroom and discharging above the hotel roof. This arrangement of apparatus not only gives thorough ventilation but brings in the cool air at a point where it will not be unpleasant to the occupants. In fact, the system works so well that the laundry fan is run only on special occasions. Throughout the building there are also numerous electric driven ventilating fans for rooms requiring special ventilation.

As already stated, the main lobby, dining rooms, and other public rooms are heated by a system of indirect ventilation—that is by the steam coils in connection with the ventilating fans. The guest rooms and other parts of the building are heated by a system of direct radiation, the radiators being supplied entirely by exhaust steam. A double set of vacuum pumps are provided to remove the condensed steam from the radiators and mains and pump it into the Cochrane heaters used for supplying water to the boilers.

Refrigerating and Vacuum Cleaning Apparatus.

The hotel has a complete refrigerating system which includes a Vulcan Iron Works refrigerating machine and a 6x4x6 Worthington pump which circulates brine for refrigerating purposes in the various cold storage rooms throughout the building. This plant has a capacity of five tons of ice and twenty tons of refrigeration daily. In connection with this equipment, there is provided an ice shaving and cubing machine, driven by an electric motor, for preparing ice used in the buffet, dining rooms, etc.

The vacuum cleaning outfit consists of a steam driven vacuum sweeper having a capacity of eight lines. When operating at 120 r.p.m. this machine develops a vacuum of 14 inches. In conjunction with this sweeper there is an air compressor for blowing out the sweeper lines when they become stopped up in any manner.

Elevators.

Throughout the hotel all elevators are of the hydraulic plunger type. These consist of five passenger, one freight and two service elevators. For operating these elevators there are three 16x25x18x13½ compound duplex hydraulic pumps maintaining a pressure of 140 lb. per square inch. Two pumps only are required even with all elevators in use; hence, the third pump is held in reserve.

This pumping equipment is supplemented by the usual main and auxiliary pressure tanks, air pumps, and other similar accessories required by a first class hydraulic elevator plant. There is also a complete equipment of electrical apparatus for the elevator signals.

Applications of Electricity.

After reading this description of the new power plant and noting its large capacity, the reader has no doubt concluded that electricity is used extensively throughout this institution. Such is the fact and the importance of electricity as a potent factor in its operation could not be thoroughly appreciated without a trip through the various departments.

The largest variety of applications is found in the laundry which is complete in all details and prepared to handle any class of work. Here electricity is used for light, heat, power and communication.

The heaviest of this equipment comprises six washing machines and five extractors or centrifugal wringers, arranged in two rows, and driven from two line shafts operated by a 25 h.p. motor. There are also two driers of the conveyor and sectional type each driven by motors of one h.p. capacity.

Other machines in this department include a sleeve ironer, a band ironer, a collar and cuff machine, a bosom press, two body ironers, a finishing table and two large mangles; the latter driven by individual motors having reversible speed controllers. Some of the other machines mentioned have individual motors and many are driven in groups from a line shaft. The body, sleeve and band ironers are also electrically heated. In addition ten electric irons of various sizes and makes are in use.

In the kitchen are two motor-driven dish-washing machines; on the fourteenth floor electric motors operate the silver polishing machines, and the presses in the printing room; in the sewing room there are six machines having individual motors. In the entire building the output of electric motors aggregates about 125 h.p. Practically all of the motors are wound for 220 volts, although a few of the smaller ones are 115 volt machines. All of the heating apparatus is operated at 118 volts.

Another interesting application of electricity is found in the men's grill. Here the range is entirely dependent upon electricity. It is divided into two sections used alternately one week at a time. Each section contains numerous small compartments and a large oven. In this range special heating units are not used; Krupp wire being used entirely for this purpose. This wire is wound in spirals and mounted upon porcelain insulators. The various sections are operated at almost a white heat and each section is connected directly across the 236 volt circuit, with no provision for more than one heat.

Means of Communication.

In the operation of a large hotel, first class service is dependent upon an efficient means of communication between the guest rooms, office, various departments and the outside world. For this service the modern telephone equipment is of course, without a superior, but it is usually supplemented by the pneumatic-tube system. In this hotel the very best of telephone service is supplied by the Pacific Telephone & Telegraph Company, who have spared no expense in providing the necessary equipment. Telephones are used extensively throughout the entire building, aggregating about 780 instruments. On the main floor just back of the clerk's desk there is a special six-position Western Electric switchboard. During the hours of heavy traffic five operators and a chief operator are on duty—at other times the number varies according to the demand for service.

Connection between this switchboard and the main telephone office in Bush street—known as the Douglas exchange—is made by 28 trunk lines. No special trunk lines for toll connections are provided, but long distance communication can be held from any phone connected to the exchange. From this exchange there are many long distance calls. The number is not surprising, however, when it is remembered that the toll lines of the Pacific Telephone & Telegraph Company completely cover five entire States on the Pacific Coast. Calls for Los Angeles, 500 miles distant, are frequent and occasionally communication is held with Seattle, 1000 miles from San Francisco.

A terminal room containing all of the necessary line and trunk relays, protective apparatus, cable connections and other accessories is situated directly under the switchboard on the main basement floor.

The storage battery and its controlling panels are also installed in this room. Two batteries, each consisting of twenty "Chloride Accumulator" cells having a capacity of 120 ampere hours are required for this system—one set being charged while the other is in use. Charging current is taken directly from the main distributing board through a panel containing suitable instruments, charging rheostats and transfer switches. The terminal room apparatus, as well as the switchboard has an ultimate capacity of 1200 lines which will probably be used in the near future. The storage cells are mounted in cabinets which are thoroughly enclosed and ventilated to prevent acid fumes from deteriorating other apparatus in the same room. This system is directly in charge of the telephone company, who have an attendant on duty during the day. His time is devoted entirely to the telephone installation. At night the hotel can call assistance if necessary from the main office.

Public telephone stations of the Pacific Telephone & Telegraph Company and the Bay Cities Telephone Company are also located in this hotel. As an additional means of communication the Postal and Western Union Telegraph Companies maintain offices in the hotel lobby.

Pneumatic Tube System.

For the transmission of orders, letters, etc., a pneumatic-tube system of the vacuum type, supplied by the Lamson Consolidated Store Service Company, has been installed. A blower, required for the operation of this system, is placed in the main basement near the ice machine. It is driven by a variable speed motor automatically controlled by a special regulating device which changes the speed according to the amount of vacuum required. Low voltage current for operating the valves at the various tube terminals is furnished by a small motor generator set, placed near the regulating device. The tube clerk's room or main station is on the main floor, near the telephone switchboard.

As part of the means for communication, the electric carriage call system may also be included. The calling or signalling is entirely silent and is done with apparatus manufactured by the Electric Carriage Call Company.

In the indicator there is a nest of special receptacles, each containing a small lamp, so arranged that by lighting the proper lamps any number from 1 to 999 may be formed—there being three groups or sets of receptacles.

Control wires from the indicator run to a special switch near the main entrance. This switch is made up of a series of upper and lower contacts, the former terminating flush with a rubber plate holding them in place and insulating one from the other—and the latter in the form of round spring-actuated plungers, all mounted upon a common handle or support. Each set of contacts is arranged in the same relative position as the corresponding lamp controlled.

When it is desired to show a certain number on the call a card bearing perforations forming that number is placed in the switch between the contacts. Then the handle is pressed down, allowing all contacts necessary in forming the required number to come together. When the handle is released, all contacts separate and the numerals disappear.

Lighting.

The lighting of the entire hotel [illegible] Sunbeam incandescent lamps are used. While a large number are tungsten lamps, there are also a number of tantalum and carbon filament lamps. All types include a large variety of special size and candle-power.

Throughout the various public rooms there are a number of beautiful fixtures and particularly in the main dining-room and ball room are the fixtures of exceptional artistic and mechanical design. Large electroliers are suspended from the ceilings and in many rooms these are supplemented by artistic wall brackets in keeping with the room decorations. The guest rooms and halls are also well lighted.

The exterior lighting of the hotel has been carried out on a large scale and is probably the most beautiful installation of the kind in the West. The entire [illegible] of the building from the [illegible] to the roof is strung with electric lights. The system is a permanent one [illegible] receptacles placed [illegible] together [illegible] of the building [illegible] Altogether there are about 2000 [illegible] filament lamps.

[illegible]

steam piping by the Moore & Scott Iron Works, while the entire new electrical apparatus was furnished by the Western Electric Company, who also installed the generators. The switchboard equipment and wiring was installed by Mr. W. H. Kimball, chief electrician of the hotel, under the direction of Mr. M. Haley, who is chief engineer in charge of the entire plant. The writer is indebted to the hotel staff for much of the information in this article and also to Mr. A. Z. Hirsch for drawing the various diagrams throughout the article.

AN EARLY APPLICATION OF ELECTRIC POWER FOR INDUSTRIAL PURPOSES IN SAN FRANCISCO.

[illegible]

In the year 1877 an attempt was made to supply electric light in San Francisco. The plant comprised a vertical steam boiler and engine of about 15 h.p., a Siemens dynamo electric machine of about 2 h.p., a Gramme alternator and its exciter with a capacity of [illegible] candles, located in a loft at 412 Market street. Stephen D. Field was the electrician of the [illegible] and the location of the plant on the third [illegible] of the building necessitated much labor in hoisting the necessary wood and coal by means of a primitive hand operated elevator. Mr. Field conceived the [illegible] that he could avoid a good deal of manual labor and incidentally carry out some experiments by belting [illegible] machines to the elevator.

[illegible] he fixed a grooved pulley to the shaft [illegible] Siemens machine and prepared an endless rope [illegible] passed around the elevator rope wheel [illegible] of the Siemens machine; then, feeding [illegible] the Gramme exciter to this Siemens machine [illegible] had an installation of electric power which [illegible] use until the affairs and machinery [illegible] months later.

[illegible] having been a resident of San Francisco [illegible] has been closely [illegible] believes this to have [illegible] electric power industrially [illegible]

INTERNATIONAL CONGRESS OF THE APPLICATIONS OF ELECTRICITY, TURIN, 1911.

[illegible] International Congress of the Applications of [illegible] at Turin from the [illegible] to the [illegible] the [illegible] and under [illegible] Italian Electrotechnical Association [illegible] Italian [illegible] Committee during [illegible] Exhibition of Industry [illegible]

Purification of boiler feed water so as to prevent [illegible] three English [illegible] the scale [illegible] that a soft mud [illegible]

PRESENT STATUS OF PRODUCER GAS FROM CRUDE OIL.

DEPTH OF SNOW IN THE SIERRA.

BY PROFESSOR A. G. McADIE.

It is a matter of general interest to the public and of special significance to the engineer to have some clue as to the prospective water supply and the probable rate of melting of the snow in the mountains. We are fortunate in California in that for many years through the co-operation of the engineering corps of the Southern Pacific Company and the Weather Bureau, records of the depth of snow have been maintained for a long period. The snow problem is an important one and while we are not altogether satisfied with methods of determining the water content of a given snow cover, the scale measurements of depth of snow furnish a basis for comparing any one year with another.

One of the most important snowfall stations in the country is that at Summit, Placer County, California, elevation 7,017 feet. The table given below

SEASONAL SNOWFALL AT SUMMIT, CAL.

Elevation, 7017 feet; latitude, 39° 19' N.; longitude, 120° 10' W.

Winter of	Snowfall. Inches	Winter of	Snowfall. Inches.	Winter of	Snowfall. Inches.
1870-1	300	1884-5	202	1897-8	262
1871-2	550	1885-6	462	1898-9	481
1872-3	334	1886-7	422	1899-1900	406
1873-4	200	1887-8	345	1900-1901	440
1874-5	284	1888-9	261	1901-2	373
1875-6	525	**1889-1890**	**776**	1902-3	407
1876-7	178	1890-1	335	1903-4	434
1877-8	341	1891-2	380	1904-5	375
1878-9	446	1892-3	634	1905-6	514
1879-1880	**783**	1893-4	511	1906-7	602
1880-1	154	1894-5	685	1907-8	340
1881-2	492	1895-6	544	1908-9	442
1882-3	299	1896-7	560	1909-10	342
1883-4	482			1910-11 (to date.)	402

shows that there has been an accumulated depth of snow on the ground frequently exceeding 20 feet; also that the total seasonal snowfall has several times exceeded 50 feet, and in two seasons has exceeded 60 feet.

I have been informed by Professor George Davidson that in the season of 1868-9 the engineer in charge of construction of the Central Pacific Railroad, Mr. Judah, reported a seasonal fall of 60 feet. Our records however do not begin until 1870. I think the record published herewith constitutes the longest period of snowfall measurements in our country. Certainly it is one of great value.

In 1908 Professor J. N. Le Conte, using this table as a basis, published in the Sierra Club Bulletin a short paper having for its special purpose the possibility of predicting the probable date of disappearance of the snow with the view of determining when travel would be safe through the mountains. The attempt was made to get the average rate of melting. Eleven plats showing the depth of snow on the ground for eleven different years were discussed. In each of these there was an extremely irregular curve, increasing until the last week in March. After the end of March the curve decreased rapidly and was fairly smooth. In the accompanying illustration there is shown the average depth of snow on the ground at Summit with a maximum of 129 inches about March 26th. The curve ABCD is the average depth of snow obtained by tak ing the total depth for the 10 years for a given date

SUMMIT, PLACER CO., CAL. (Elevation, 7,017 feet.)

Season.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Seasonal	Year	Annual
1870-71	.....	.....	.....	.....	.....	.....	7.60	7.55	4.05	4.00	0.31	0.89	.....	1871	60.60
1871-72	0	0	0.30	0.40	8.50	27.00	1.00	16.10	5.90	5.60	0.30	0	68.10	1872	37.90
1872-73	0	0	0	0	0	6.00	2.31	16.20	6.05	2.55	2.11	0	35.22	1873	40.95
1873-74	0.03	T	0	0	0	11.70	5.00	0	0	2.00	3.60	T	22.33	1874	18.85
1874-75	0	0	0	3.80	3.60	0.85	8.15	0.12	4.80	0.80	1.46	2.55	26.13	1875	*33.86
1875-76	T	0	0	*2.23	6.50	7.25	14.65	8.70	13.80	2.60	1.60	T	*57.33	1876	46.90
1876-77	1.21	0.10	0.56	2.98	0.50	0.20	8.90	0.69	3.44	4.84	3.75	0.12	27.29	1877	26.73
1877-78	0	0	0.30	0.55	3.34	0.80	10.00	11.50	3.05	2.40	1.60	0	33.54	1878	32.69
1878-79	0	0.09	0.44	1.91	0.80	1.60	13.65	8.70	21.05	4.52	2.55	0.10	54.71	1879	73.67
1879-80	0	T	0	4.20	5.60	13.30	6.60	7.50	8.90	30.40	3.60	0	80.10	1880	64.50
1880-81	0.80	0	0	0	0.50	6.20	7.50	4.60	1.50	1.00	0.05	0.50	22.65	1881	30.95
1881-82	0	0	0.60	3.10	3.05	9.05	7.40	9.00	19.30	3.25	0.60	0	55.35	1882	62.12
1882-83	0	0	0.75	12.95	3.95	4.92	1.00	2.60	7.70	3.40	3.42	0	40.69	1883	23.57
1883-84	0	0	0.10	0.95	1.20	3.20	7.60	12.70	9.10	12.60	0.80	4.04	52.29	1884	60.47
1884-85	0	0	1.10	3.13	0	9.40	1.40	0.58	0.10	4.88	1.00	0.80	22.39	1885	25.41
1885-86	0	T	0.05	0	13.60	3.00	13.90	1.40	7.80	6.40	0.95	0	47.10	1886	41.00
1886-87	0	0	0	3.10	1.70	5.75	6.25	20.70	1.40	5.80	0.95	1.60	47.25	1887	49.97
1887-88	0.10	T	T	0.07	1.50	11.60	9.20	1.29	8.05	2.30	1.04	3.72	38.87	1888	36.55
1888-89	3.51	0.28	0	0	1.90	5.26	1.00	1.50	9.55	1.90	6.30	0.22	31.42	1889	51.42
1889-90	0	0	0	5.65	6.80	18.50	19.20	11.60	14.00	2.60	0.25	0	78.60	1890	55.05
1890-91	0	0	0	0	0	7.40	1.50	1.38	5.10	4.60	1.10	0	21.08	1891	*26.13
1891-92	0	0	*0.20	0.05	0.30	11.90	4.00	3.40	7.40	4.50	6.30	0.20	*38.25	1892	44.70
1892-93	0	0	0	0.60	8.80	9.59	7.90	10.80	14.50	9.20	0	0	61.30	1893	52.30
1893-94	0	0	0	0.30	3.60	6.00	15.50	15.25	3.40	4.30	2.40	0	50.75	1894	69.75
1894-95	0	0	0.50	2.90	1.00	24.50	25.80	4.20	4.70	2.50	2.40	0	68.50	1895	49.50
1895-96	0	0	0.20	0	1.40	8.30	10.50	0.70	9.70	18.20	5.40	0	54.40	1896	*62.43
1896-97	*0.21	*0.02	0.40	0.90	12.30	4.10	4.05	14.35	18.00	1.25	0	0.70	*56.28	1897	47.73
1897-98	0	0	0.03	2.50	2.65	4.20	4.00	7.10	5.20	0.80	2.90	0.90	31.28	1898	31.40
1898-99	0	0	0	4.40	2.50	3.60	12.70	5.20	15.75	1.75	3.60	0.70	50.20	1899	73.80
1899-00	0	1.00	0	16.05	9.15	7.90	7.25	4.75	8.15	4.80	3.97	0.50	61.52	1900	42.52
1900-01	0.25	T	0.95	3.50	6.90	3.50	11.30	14.20	4.50	5.50	1.00	0	51.60	1901	49.60
1901-02	0	0	1.40	4.20	4.70	2.80	4.00	16.30	8.90	3.00	1.10	0.30	46.70	1902	49.00
1902-03	0	1.00	0	2.30	7.50	4.60	10.50	3.20	11.10	1.70	0.80	T	42.70	1903	40.50
1903-04	0	0	0	1.20	11.20	0.80	4.20	30.40	21.30	3.90	0.23	0.05	73.28	1904	76.54
1904-05	0.04	0.03	4.56	1.90	1.33	8.60	5.55	7.00	10.70	2.90	3.70	1.40	47.71	1905	43.85
1905-06	T	0	0.50	0.60	7.80	3.70	14.10	9.30	11.75	2.60	4.12	2.10	56.57	1906	57.55
1906-07	T	1.00	0.32	0.12	2.04	10.10	13.50	4.38	27.36	2.66	3.06	2.22	66.76	1907	66.48
1907-08	0.12	T	0.06	2.52	0.40	10.20	3.50	4.50	10.20	1.14	3.70	0.44	36.78	1908	33.28
1908-09	0	0.76	1.20	1.54	3.60	2.70	29.11	8.94	4.60	0.40	1.10	0.88	55.16	1909	*60.62
1909-10	0	0	0.72	1.66	*4.58	8.30	8.64	5.10	4.98	0.68	0.53	0	.....		.....
1910-11	1.16	0	2.82	0.50	5.46	4.08	28.90	5.30	.....	.....	.....	.....	.....		.....
Means	0.16	0.11	0.39	2.35	3.97	7.39	8.78	7.91	9.02	4.60	2.13	0.64	48.29		48.07

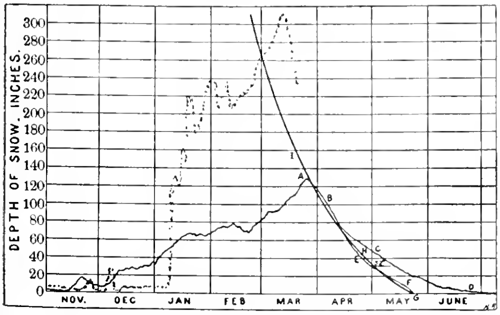
Total precipitation, including melted snow; ratio ten to one

SUMMIT, PLACER CO., CAL. (Elevation, 7,017 feet.)

	J	A	S	O	N	D	J	F	M	A	M	J	Inches
1878	.....	.....	.....	.....	.....	...	100.0	115.0	30.0	24.0	16.0	.....	.....
1878-79	.....	.....	4.2	12.1	8.0	6.0	77.5	57.0	209.0	45.2	25.5	1.0	445.5
1879-80	.....	T	0	42.0	56.0	133.0	66.0	75.0	89.0	298.0	24.0	....	783.0
1880-81	.....	.....	.....	.....	5.0	62.0	45.0	16.0	15.0	10.0	0.5	.....	153.5
1881-82	.....	.....	6.0	26.0	30.5	43.0	65.5	90.0	193.0	32.5	6.0	.....	492.5
1882-83	.....	.....	7.5	27.5	39.5	49.5	10.0	26.0	72.0	34.0	33.0	...	299.0
1883-84	.....	.....	.....	9.5	12.0	32.0	76.0	127.0	91.0	126.0	2.0	6.0	481.5
1884-85	.....	.....	11.0	21.0	0	94.0	14.0	5.0	1.0	38.0	10.0	8.0	202.0
1885-86	.....	.....	.....	.....	136.0	30.0	131.0	14.0	78.0	61.0	9.5	.....	462.5
1886-87	.....	.....	.....	31.0	17.0	34.0	56.0	207.0	11.0	58.0	5.0	.....	422.0
1887-88	.....	.....	.....	T	15.0	116.0	92.0	7.0	80.5	21.0	4.0	9.5	345.0
1888-89	.....	.....	.....	.....	16.5	39.0	10.0	15.0	95.5	19.0	63.0	3.0	261.0
1889-90	.....	.....	.....	24.0	61.0	185.0	192.0	116.0	147.0	26.0	25.0	.....	776.0
1890-91	.....	.....	.....	.....	.....	74.0	15.0	138.0	51.0	46.0	11.0	.....	335.0
1891-92	.....	.....	.....	0.5	3.0	119.0	40.0	34.0	74.0	45.0	63.0	2.0	380.5
1892-93	.....	.....	.....	6.0	88.0	95.0	79.0	108.0	145.0	92.0	21.0	.....	634.0
1893-94	.....	.....	3.5	3.0	36.0	60.0	155.0	152.5	34.0	43.0	24.0	.....	511.0
1894-95	.....	.....	5.0	29.0	10.0	245.0	258.0	42.0	47.0	25.0	24.0	.....	685.0
1895-96	.....	.....	2.0	0	14.0	83.0	105.0	7.0	97.0	182.0	54.0	.....	544.0
1896-97	.....	.....	4.0	9.0	123.0	11.0	40.5	143.5	180.0	12.5	0	7.0	560.5
1897-98	.....	.....	0.5	25.0	26.5	12.0	40.0	30.0	52.0	8.0	29.0	9.0	262.0
1898-99	.....	.....	.....	34.0	25.0	36.0	127.0	52.0	157.5	17.5	32.0	.....	481.0
1899-00	.....	.....	.....	89.0	29.0	79.0	41.0	38.0	79.0	42.0	9.0	.....	406.0
1900-01	.....	.....	1.5	21.0	60.0	15.0	113.0	120.0	45.0	55.0	10.0	.....	440.5
1901-02	.....	.....	14.0	22.0	12.0	10.0	19.0	163.0	89.0	30.0	11.0	3.0	373.0
1902-03	.....	.....	.....	23.0	75.0	46.0	85.0	32.0	111.0	27.0	8.0	.....	407.0
1903-04	.....	.....	.....	1.0	22.0	8.0	12.0	172.0	148.0	39.0	2.0	.....	434.0
1904-05	.....	.....	3.0	14.0	12.0	66.0	50.0	64.0	107.0	23.0	34.0	2.0	375.0
1905-06	.....	.....	5.0	0	78.0	37.0	138.0	82.0	109.0	26.0	36.0	3.0	514.0
1906-07	.....	.....	.....	T	18.0	98.5	136.0	26.0	265.0	21.0	19.0	19.0	602.0
1907-08	.....	.....	T	3.0	4.0	101.0	35.0	45.0	102.0	12.0	37.0	1.0	340.0
1908-09	.....	.....	T	10.0	36.0	27.0	226.0	82.0	46.0	4.0	11.0	.....	442.0
1909-10	.....	.....	.....	9.0	59.0	83.0	86.0	51.0	12.0	8.0	4.0	.....	312.0
1910-11	.....	.....	.....	3.0	30.0	33.0	283.0	53.0	.....	.....	.....	.....	.....

Snowfall each month at Summit.

and dividing by 10, using zeros for such years as have bare ground. To get a more correct rate of melting however we find the average date at which there was a given depth; for example, the mean date at which all snow is off the ground at Summit is May 26th; the mean date at which it is 20 inches deep is May 10th. In this way Professor LeConte obtained the curve marked in the diagram ABEFG; and disregarding small irregularities, calls the smooth curve HIG the mean curve of melting.



Curve of Snowfall at Summit, Cal. Dotted line Shows Depth of Snow on Ground Season of 1910-11 to date.

The actual curve of melting for any year can be compared with the mean curve and if it falls below the mean there is every probability that the season will be an open one; i.e., that travel in the mountains will be possible at a much earlier date than where the curve of melting exceeds the mean.

During the present year the depth on the ground was much below the mean until about January 9th, when the amount was increased rapidly. Notwithstanding some losses the depth up to the 9th of March is so far in excess of the average that we cannot reasonably expect an open season, so far as travel is concerned. On the other hand the abundant supply of snow offers every reason for expecting a bountiful water supply during the long summer months. This of course is of significant value to engineers, farmers and stockman.

A public utilities commission for California is provided in three constitutional amendments which have passed the legislature and are to be submitted to the people's vote. They provide for the reorganization of the present railroad commission, increasing its membership from three to five, to be appointed by the Governor for six-year terms, and extending its power of control over all public utilities in private ownership, including commercial, interurban and street railways, canals, pipe lines, plants and equipments for the transportation or conveyance of passengers or express matter or freight, including crude oil. The new commission is to have jurisdiction over telegraph, telephone, heat, water, light and power companies and concerns that furnish storage or wharfage facilities, as well as common carriers. Every class of private corporations, individuals or associations which the legislature may put under the head of public utilities will be subject to the commission's control and regulation, and it will have the right to fix rates to be charged for commodities furnished or services rendered by public utilities. The powers respecting public utilities now vested in the governing bodies of cities and towns shall be retained by them unless a majority of the electors of a county, city or town vote to surrender such powers to the commission.

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NOTICE TO ADVERTISERS
Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Roosevelt on the Recall of the Judiciary

Two weeks ago this paper expressed its views against the action of the California Legislature in passing a bill providing for an amendment to the constitution giving to the people the right to the recall which shall include the judiciary. This bill has been held by the proponents of popular and progressive government as being in accordance with the principles on which it is founded. It is a pleasure to note the views of Col. Roosevelt the admitted leader of the progressive movement, in his speech at Phoenix, Ariz., given in the plaza of that city, in which he reiterated his belief in the recall for Arizona, but disapproved its extension to include the judiciary, for, as he says, "it tends to produce timid courts and judges who keep their ears to the ground."

The Mexican Revolution

It is difficult to determine from the reports of the daily press whether the revolution in Mexico is real war or opera-bouffe. The muck-raking magazines tell about "Barbarous Mexico," though the justice of the appellation is hotly contradicted by proponents of the federal government. It is easy to believe that the present condition is both barbarous and serious, barbarous in the degenerate use of soft-nosed bullets by both parties without provision for either doctors or hospital appliances, and serious in suspending mining operations. This affects the power plants and in fact every industry, as in the mining districts everything is dependent upon mine operation.

Fanatic warfare affords little prospect of protection for American financial and engineering interests and it is to be hoped that Uncle Sam's moral influence, at least, will have its effect in terminating not only the reported barbarities, but the baneful interference with business.

Water Power Location

Every year, especially in the spring, there is a crop of new water right locations on most of the streams which have power possibility. These locations are sometimes made by people who really know the responsibilities and difficulties to be encountered in establishing an hydroelectric system, but by far the greater number see the fancied pot of gold at the end of the rainbow consisting of a little work, a lot of big talk and a water location.

Many of these locations contemplate the use of far more water than the stream can supply, except at flood periods, and often such a location is made where former rights would have precedence or where the low water flow is already used by existing plants. Oftentimes a market already well supplied is shown as the possible source of income, with the intimation that some competition would be necessary. This has been the weak point in financing these power schemes, even

where, upon examination, it is shown that the power was really available. For the financier likes not the idea of heavy competition in a limited field and a long wait for dividends.

There are undoubtedly many good so-called power sites whose development has not been considered by the most inexperienced dreamer, because their isolation and distance from any visible market has precluded a foresight of their possibilities. These, however, will be the great plants of the future. Each year new markets for this power are created and locations which in the previous year seemed visionary are taken up and profitably developed.

P. A. Y. E. Cars

The first pay-as-you-enter cars were placed in service in San Francisco this week. It is yet too soon to pass judgment on the successful outcome of this venture by the United Railroads. A service of this kind must be governed more or less by the local conditions surrounding the operation and in San Francisco these conditions are perhaps more severe than in any other city. This is true both on account of the length of runs, the many and severe grades, the abnormally heavy traffic, a habit of overcrowding and a public antagonism which has been engendered by a service woefully lacking in equipment and power. With the advent of the new cars the latter condition will be undoubtedly relieved and an entire new power equipment, ample in all respects, has been installed.

It is a curious fact that some proposed expedients are frowned upon by intelligent people who can give many arguments and reasons why they should fail, but which, when tried, disprove the popular prediction and are eminently successful. This has been specifically the case with the pay-as-you-enter service. This service is now in use in many cities with most gratifying success. The same adverse opinions are heard in San Francisco, but there is no proof that the favorable results of other cities may not be duplicated here. It is to be hoped that the public will take kindly to this new service and meet the railway half way in its attempt to better conditions.

Municipal Street Railways

In this day when public service corporations are indiscriminately accused of all sorts of graft and crookedness, their officials held up to public scorn on the slightest pretext and legitimate business constantly menaced through careless public opinion, municipal ownership and control of public utilities is a fetish in the popular mind, a panacea for all ills. Of course there is some foundation for what now seems unreasonable prejudice, because a decade or more ago these same companies were not always operated with that consideration for the people's rights which is almost universal today. The most radical may argue that a wrong-doer who goes unpunished, but who is caught many years later, is just as liable to punishment. But such sentimentalism in valuing stocks and bonds is the height of absurdity.

The sale of the municipal bonds for San Francisco's Geary street railroad is interesting to financial institutions and to the economist. The first offer of $600,000 in these bonds found no bidders; the second offer has brought out a few subscribers, some savings banks, but mostly individuals, whose total subscription is only $93,000. San Francisco bonds have, as a rule, been sold at a premium and in many cases entire issues have been underwritten by one or more of the great bond houses. As a reason for this showing public opinion conjures up an insidious influence over the great bond houses by the public service corporations. It is argued that a new and baneful precedent will be established to interfere with their business. On the other hand the companies argue that records show that municipally operated street railroads are usually a failure in America. In this case the establishing of a municipal utility likely to fail should be of the greatest interest to the existing company.

The reason is undoubtedly more far reaching and must be traced to the individual reticence of the bond subscriber in placing his money where it will be handled by the public conscience for the good of the community rather than by the private specialist who is after the greatest results for all concerned.

Electricity in Agriculture

Agriculture, though our greatest industry, is that most neglected by the central station. High tension transmission lines crossing the richest farm lands on their way from water-fall to city hall are like limited trains giving no intermediate accommodation to the farmer. His most pressing needs for the operation of stationary machinery have been ably supplied by the gas engine, even to the point of driving the generator for electric lighting. But his main reliance for power in the field has always been on the horse, which may truly be said to have gone "back to the farm." Even this last refuge has been invaded by the engine or motor, which tires not, neither does it eat off its head while idle. Deep ploughing especially is necessary to increase the yield per acre. A six or seven inch furrow is as deep as can be ploughed by a team of horses, while the requisite depth of twelve to fourteen inches can be practically obtained only by mechanical plows. For tillage and harvesting also the horse is inadequate and inefficient, costing about eight cents per horsepower hour and usually scrapped after ten years' useful service.

In America the gas and steam engine has been most widely adopted as a mechanical substitute for the horse, but in Germany and France the electric motor has proved superior in economy, flexibility and simplicity. Here, then, is a fallow field for the central station.

PERSONALS.

L. H. Bean, superintendent of the street railway system in Tacoma, is at San Francisco.

J. M. Hunt, of Hunt, Mirk & Co., has been spending a few days in the Santa Cruz mountains.

V. M. Steadman, secretary of the National Electrical Works of Los Angeles, recently visited San Francisco.

A. L. Snyder, chief engineer of the Seattle Electric Company of Seattle, Wash., was a recent San Francisco visitor.

Kempster B. Miller, of McMeen & Miller, electrical engineers, is at Los Angeles on telephone engineering business.

A. M. Hunt is making an engineering examination in Amador County, in connection with a possible power development.

William Hoopes, the electrical engineer, with the Aluminum Company of America, is at Los Angeles en route to the East.

Don C. Ray has been made manager of the Contra Costa district of the Pacific Gas & Electric Company, vice Joseph Mayo, resigned.

G. W. Manley, who is connectetd with the Crescent City Water, Light & Power Company, has returned to Crescent City from San Francisco.

A. D. Fischer, president of the Schutte & Koerting Co., of Philadelphia, has returned East after an extensive trip throughout the Pacific Coast.

W. S. Iliff of Denver, who is associated with the management of the United States Light & Traction Company, recently visited San Francisco.

H. M. Cooper has been appointed manager of the newly-created Placer district of the Pacific Gas & Electric Company, with headquarters at Auburn, Cal.

Bion J. Arnold, who has a national reputation as a consulting electrical engineer in connection with electric traction problems, is at San Francisco.

F. Boardman Clapp, Jr., has arrived from the East and joined the electrical engineering staff of the General Electric Company's San Francisco office.

Geo. R. Murphy of Pierson, Roeding & Co., has recovered from a severe attack of pneumonia of ten weeks' duration and is again at his San Francisco office.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company of Chicago, returned to his San Francisco office this week from Los Angeles.

H. W. Jackson, assistant general manager of the Sierra & San Francisco Power Company, visited the Stanislaus power station near Vallecito during the past week.

L. N. Peart, general superintendent of the San Joaquin Light & Power Company, recently spent a few days at San Francisco, making his headquarters with J. G. White & Co.

F. Seerberger, an electrical engineer, passed through San Francisco from the Orient last week, en route to Germany to interest capitalists in an enterprise which he has in plan at Tokio.

F. J. Southerland, formerly with the electrical distribution department of the San Francisco Gas & Electric Company, has been made manager of the newly-created Antioch district of the Pacific Gas & Electric Company.

S. D. Richmond, president of the Richmond Machinery Company of Salt Lake City, was at San Francisco this week and placed a contract for a large Pelton water wheel for a hydroelectric installation in the State of Utah.

G. H. Hill, assistant engineer of the General Electric Company's railway and traction department, has arrived from Schenectady and is paying a visit to the company's San Francisco offices. He is accompanied by M. M. Corbin, who is also an assistant engineer in the railway and traction department.

F. H. Varney, engineer of operation and maintenance of the Pacific Gas & Electric Company's steam engineering department, returned to San Francisco last Tuesday after making an extensive Eastern tour. He visited the principal electrical power plants and factories in the East with a view to the installation of new steam turbines and a steam heating system at San Francisco.

Newly elected associate members of the American Institute of Electrical Engineers include E. M. Baldwin, electrician Noble Electric Steel Co., Heroult, Cal.; H. J. Briggs, operator Pacific Light & Power Co., Los Angeles, Cal.; Alfred Cook, switchboard operator Washington Water Power Co., Rearden, Wash.; H. B. Bishop, electrician Stone & Webster, Sumner, Wash.; W. P. L'Hommedieu, salesman Westinghouse Electric & Manufacturing Co., San Francisco; A. W. Lindgren, superintendent Huntington Beach Co., Huntington Beach, Cal.; F. H. Mayer, draughtsman Southern California Edison Co., Los Angeles, Cal.; J. D. Morton, local manager Idaho-Washington Light & Power Co., Pullman, Wash.; E. R. Nigh, assistant electrical engineer, Seattle Electric Co., Seattle, Wash.; Albert Stafford, Bay Cities Home Telephone Co., San Francisco; E. A. Wilcox, assistant superintendent Great Shoshone & Twin Falls Water Power Co., Twin Falls, Idaho.

TRADE NOTES.

Clarence E. Delafield has been appointed district manager for Crocker, Wheeler & Co., at Boston, Mass., vice R. N. Barnes, resigned.

B. C. Holst, district manager for the Northern Electric & Mfg. Co., Ltd., at Vancouver, B. C., announces their removal on March 1st, to the six story warehouse at 313 Water street.

The Southern Pacific ferry steamer "Piedmont" on San Francisco Bay, has been equipped with three hundred 40-watt tantalum lamps and E-5 Holophane shades by the General Electric Company.

The Compressed Air Machinery Company, 39 Stevenson street, San Francisco, have been apointed selling agents for the Peerless Rubber Mfg. Company of New York, manufacturers of packings, hose and belting.

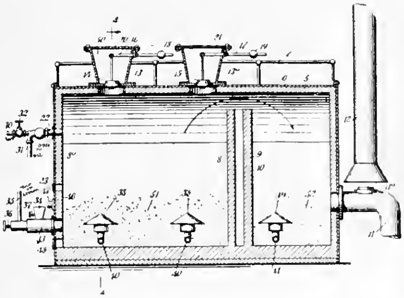
The Kellogg Switchboard & Supply Co., has closed a contract with the San Gabriel Valley Telephone Company for an extension of their plant, which covers the entire San Gabriel Valley with headquarters at Alhambra.

The National India Rubber Company of Bristol, R. I., announce that they have made a change in their agency arrangement for the Pacific Coast and in future a complete line of their rubber covered lamp cords, wires and cables will be carried at their branch office, 155 New Montgomery street, San Francisco, in charge of Otis & Squires.

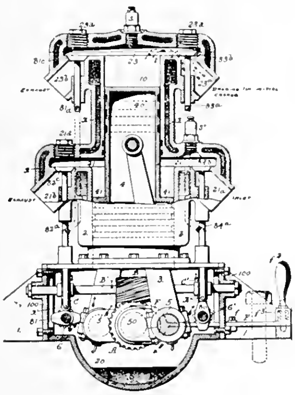
The firm of McMeen & Miller, during the past four years, has been engaged upon a specific design, construction and development of independent telephone properties in San Francisco and neighboring California cities. This work has been conducted by Mr. S. G. McMeen, member of the firm. He has devoted almost his entire time to it, largely to the exclusion of attention, on his part, to the service of other of their clients. Their work on those properties is finished. On April 1, 1911, Mr. McMeen will re-engage in general practice for their clients wherever located. As heretofore, they will practice general electrical engineering with special attention to telephony, continuing to serve municipalities and governing bodies generally in making appraisements and other investigations of public service.

PATENTS

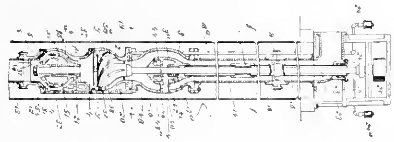
986,495. Process of Making Gas. Joshua John Nix, Alhambra, Cal. The method herein described, of making a combustible gas, which consists in reducing carbonaceous fuel to gaseous form, providing a supply of powdered carbon, drawing the same by aid of a partial vacuum into contact with said carbonaceous fuel in said gaseous form, and supplying steam to the mixture of said powdered carbon and said carbonaceous material in gaseous form.



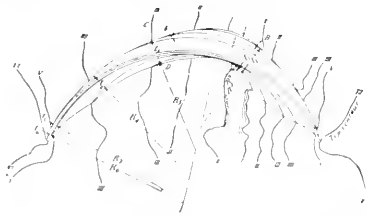
986,552. Internal-Combustion Engine. Nelson Edward Davies, San Francisco, Cal. In an explosive engine, the combination with a working cylinder and piston, the crank shaft connected with the piston, an oil holding casing that incloses the crank shaft, and the intake and exhaust valves for the working cylinder, each of said valves having a pendent member that extends into the crank chamber; of independent shafts in the casing, each having cams for co-operating with the said pendent members at their respective sides, another shaft in the casing geared with both cam carrying shafts, and direct gear connections that connect the said other shaft with the crank shaft, and shifting clutch mechanism on the crank shaft, operable from outside the casing for bringing said gear connections into and out of operative connection with said crank shaft.



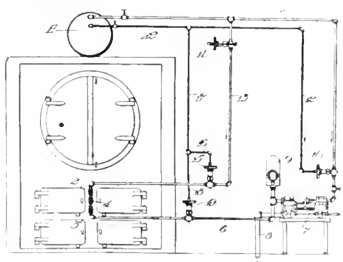
986,827. Centrifugal Pump. Franklin H. Jackson, West Berkeley, Cal., assignor to Byron Jackson Iron Works, West Berkeley, Cal. In an apparatus of the character described, a series of superposed shells or casings, said shells being of spheroidal form having inner and outer walls with a spheroidal space therebetween, said space being open at both ends, curved guide vanes in said spheroidal space, the upper one of said openings having a radially outwardly projecting flange, concentric upwardly extending pipes forming a discharge pasage between them above the uppermost shell, a revoluble shaft journaled axially within the inner pipe, and extending through the shells, upwardly divergent conical runners fixed to the shaft having their larger portions revoluble in the lower portions of the shells, said runners having annular channels between their outer and inner portions with curved arms within the channels, through which channels the liquid is lifted by a combined propelling and centrifugal force, the liquid being delivered successively from the runner through each shell and thence through a succeeding runner and pressure retaining ribs fixed exteriorly of the runner.



986 718. Dam Construction. Lars Jorgensen, Berkeley, Cal., assignor of one-half to Frank G. Baum, San Francisco, Cal. An arch dam comprising superposed arch shaped elements of varying radii and thickness, the radii and thickness of such elements varying with the widths of the canyon at the corresponding levels of such elements and bearing a definite relation to such widths and to the pressure to which they are subjected.



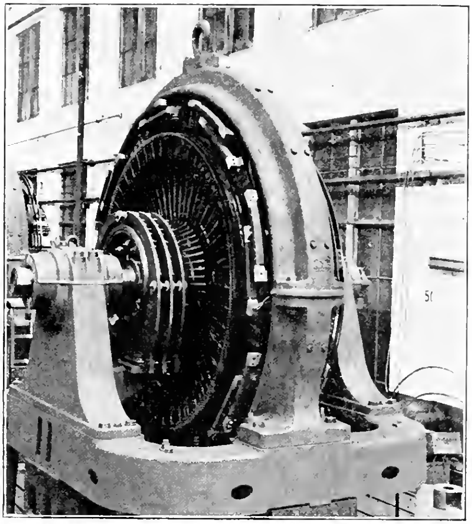
986,791. Liquid-Fuel Governor. George E. Witt, San Francisco, Cal. An oil-burning system having in combination a boiler, an oil pump, a burner having a steam pipe connected with the boiler and also having an oil pipe connected with the pump, governors in the oil and steam pipes controlled by the variations of steam pressure in the boiler, said governors regulating the steam and oil feeds independently by the boiler pressure, and means for operating the oil pump, a governor regulating the oil pump adapted to respond to a decrease of boiler pressure and to admit an increased feed of steam to the oil pump, for causing an accelerated boost to the oil pump to cause it to raise the oil pressure in the oil pipe.



INDUSTRIAL

NEW LINE OF WESTINGHOUSE ROTARY CONVERTERS.

The limitations of economic transmission of direct current necessitate either close proximity of the generator and the point of power application, or introduction of alternating current for generation and transmission. Today the two distinct systems for electrical distribution are often combined to great advantage by means of apparatus for transforming alternating into direct current. For such service the Westinghouse Electric & Manufacturing Company, has, during the past few years, developed a complete line of rotary converters. The Westinghouse rotaries of the new standard line are all self-starting.



New Type of Westinghouse Converter.

The combined efficiency of a rotary converter and transformers will usually be somewhat higher at all loads than the efficiency of a motor-generator set of equal capacity and voltage. Practically all large systems requiring change from alternating to direct current for railway or power service have adopted conversion by rotaries on account of their simplicity and compactness.

They are built in all sizes, from small machines used in the laboratory for demonstration purposes, up to units of 3000 kilowatt capacity. They are arranged for standard frequencies and voltages. The total capacity of Westinghouse rotaries now in satisfactory operation in all parts of the world amounts to more than 1,000,000 kilowatts. The new line of rotaries is completely described in Circular 1028, just issued by the Westinghouse Company.

TRADE NOTES.

The Portland Water Power & Electric Transmission Company has recently ordered from the General Electric Company, a complete electrical equipment for their new power station on the Clackamas River at River Mill Station, near Estacada, Oregon. Three 3300 kw. .9 P. F.-60-cycle, 3-phase, 11000 volt generators will be direct connected to three 600 h.p. hydraulic turbines, operating at 240 r.p.m., each generator being excited from a 60 kw. direct connected exciter. An additional exciter unit, consisting of a hydraulic turbine driven set of 85 kw. capacity, is provided as a reserve in case of accident to the direct driven units. Each alternator will be connected to a 3-phase step-up transformer of the same capacity as the alternator through disconnecting and oil switches. Each transformer will feed into the bus bars or directly into the transmission line through oil and disconnecting switches at normally 57,100 volts "Y" for transmission of the power developed to Portland, Oregon. A complete switchboard with lightning arrester equipment is also included in the order.

The Geo. E. Dow Pumping Engine Co., of San Francisco, report the following recent sales: Plumas Amalgamated Mines Co., San Francisco, one 12x20x12 horizontal Simplex steam driven air compressor, capacity 500 cubic ft. against 15 lb. pressure; National Ice & Cold Storage Co., San Francisco, one 6 & 10x8½x10 horizontal compound duplex piston pump; Associated Supply Co., San Francisco, one 14x7x12 Underwriters fire pump, 500 gal.; Cia de Aguas de Santa Ana, Santa Ana, Salvador, C. A., two 11x12 in. horizontal duplex piston pumps, direct connected to two 40 h.p. motors; D. D. Demarest & Co., San Francisco, one 13x14x18 horizontal duplex air compressor, capacity 700 cu. ft., against 100 lb. pressure; Union Hollywood Water Co., Los Angeles, one 12 & 22x12 & 20x18 horizontal two-stage air compressor, cross compound, capacity 650 cu. ft. against 100 lb. pressure; California Oilfields, Ltd., San Francisco, one complete fuel oil burning set, one 500 sq. ft. suction surface condenser, one 6½x9x10 horizontal air pump, two 140 h.p. Parker water tube boilers, 150 lb. working pressure, one 12 & 22x10 & 18½x10 two-stage cross compound steam driven air compressor with Meyer cut-off engine, capacity 650 cu. ft. against 100 lb. pressure; one 16x24x5½x18 horizontal compound duplex d.p. crank and fly wheel pump and two 5¼x3½x5 boiler feed pumps.

The White River plant of the Pacific Coast Power Company at Sumner, Washington, under the direction of Stone & Webster, is being equipped with two high head Francis turbines of 18,000 h.p., under normal head of 440 feet, with a guarantee of 20,400 h.p. under a 480 foot head, supplied by the Allis-Chalmers Company. These units are direct connected to two 10,000 kw. 360 r.p.m. General Electric alternators. The plant has been designed for an ultimate capacity of six such units. The turbines are of a double discharge Francis type with a spiral case and equipped with Allis-Chalmers latest type oil pressure governors, there being two pressure regulators for each unit, each capable of discharging 100 per cent of the capacity of the turbine, one being operated directly from the pipe line pressure and the other from the gate of the turbine, so as to be used either as a water saving device or as a synchronous bypass. Both regulators are connected with the bottom of a cast steel spiral casing by a Y pipe whose mechanism is connected to a break plate bursting at 60 per cent pressure above normal. Each turbine is fed by a separate steel pipe line and the supply can be shut off entirely by means of 7 ft. butterfly valves. These valves are the largest of this type ever designed and are arranged for both electric and hand operation. All parts under pressure are to be tested to a pressure corresponding to 880 foot head (385 lbs.) resulting in a pressure on the butterfly valves of 2,200,000 lbs. The shaft of the turbine has a 16 in. diameter in the bearings and is 22 feet from bearing center to bearing center. The exciters are driven by Allis-Chalmers impulse over-hung wheels with an adjustable needle governor and regulator. These units are expected on the ground early in June, 1911, and it is hoped that the plant will be delivering power to Seattle this fall.

NEWS NOTES

INCORPORATIONS.

LOS ANGELES, CAL.—The Gas Securities Company has been incorporated by F. R. Bain, C. S. S. Forney, and R. B. Wheeler, with a capital stock of $30,000.

RED BLUFF, CAL.—The Gerber Water & Light Company has been incorporated with its principal place of business at Sacramento. It plans to construct water and light plants for the proposed town of Gerber, nine miles south of Red Bluff. The capital stock is $50,000. Edward H. Gerber, F. W. Kiesel and George W. Peltier are the directors.

ILLUMINATION.

EVERETT, WASH.—The Everett Railway, Light & Power Company will install a system of cluster lights on Wetmore avenue.

ESCONDIDO, CAL.—The Escondido Utilities Company will install a complete new system of lighting and all lamps will be on the same circuit.

YUMA, ARIZ.—A franchise permitting the sale of electric light and power has been applied for by H. W. Blaisdell and will be submitted by the City Council to a vote of electors.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has reduced the minimum price for electric power to 2½ cents per kw. as compared with the 3-cent rate of the San Francisco Gas & Electric Company.

REDDING, CAL.—The Board of Supervisors has granted a franchise to the Siskiyou Electric Light & Power Company, of Yreka, authorizing that corporation under the customary restrictions, to erect poles and lines on the public highway in Shasta County, outside of incorporated towns.

BAKER, ORE.—The city engineer has been instructed to prepare estimates for the installation of a city lighting plant. The plans propose the construction of a pipe line from Ely Creek to Salmon Creek to replace an old flume. The construction of a new reservoir of 3,000,000 gallons capacity is also proposed in the plans.

MORGAN HILL, CAL.—The Board of Trustees has passed an ordinance granting to the Coast Counties Light & Power Company, the right to erect, maintain and operate along and across the highway of the town of Morgan Hill, poles from which to suspend wires and other appliances for transmitting electric current in the town of Morgan Hill.

VANCOUVER, WASH.—The City Council has granted to the Oregon-Washington Corporation recently formed to take over the gas, water and traction systems, three 50-year franchises for those utilities and to the Mount Hood, Light & Power Company, supplying the city with electric light and power, a 50-year franchise. The Oregon-Washington Corporation agrees to spend $500,000 in improvements in the near future. A gravity water system will offer fire protection and the city will install 100 new hydrants.

YREKA, CAL.—Construction of a dam at the head of Ward's Canyon, 16 miles above Hornbrook, on the Klamath River, has been commenced by the Siskiyou Electric Light & Power Company. The dam will be 250 feet long and 90 feet high, and when completed will furnish sufficient water for the development of 20,000 h.p. of electricity. The company has patent rights sufficient for the development of 30,000 h.p. Work will soon be commenced on power lines to Klamath Falls and to Butte Creek Valley. It is expected to complete the work this summer.

REDDING, CAL.—The Supervisors, on application of the Siskiyou Electric Light & Power Company, have passed a resolution to advertise for sale a franchise to erect power and light lines on the highways of Shasta County. The franchise will be ordered for sale May 8. The franchise was asked by J. W. Churchill and Alex Poshorough, capitalists of Yreka, who are heavily interested in the Siskiyou Electric Light & Power Company. The company is one of the large power companies of California, with offices in Yreka and furnishes light and power in Oregon north of Ashland and in Siskiyou County as far south as Dunsmuir, which is near the Shasta County line.

TRANSMISSION.

KENNETT, CAL.—The power lines of the Sacramento Valley Power Company will be extended into Kennett within the next few months.

MELROSE, CAL.—The Coast Mfg. & Supply Company has contracted with the Great Western Power Company for 150 h.p., and will shut down their steam plant.

SAN BERNARDINO, CAL.—A formal proposition of the Lytle Creek Power Company for the sale of its power plant and distributing system to the city has been made.

CHICO, CAL.—It is reported that J. L. Gillenwater has sold his water rights on Deer Creek to the Sacramento Valley Power Company with which the Fleishhackers recently became affiliated and that they propose to install power equipment.

CANANEA, MEX.—The Sunset Development Company, operating in Barranca district, developing coal land, is contemplating the installation of a power house which will be sufficient to supply electricity to all the companies operating in that district.

VALDEZ, ALASKA.—T. G. Quinn, superintendent of the Alaska Water, Light & Telephone Company, announces that improvements will be made to the local plant. A new and improved switchboard will be installed, numerous improvements to the light and power plant will be made increasing the voltage from 2300 as at present to 13,000.

SAN BERNARDINO, CAL.—For the purpose of supplying pumping power to settlers in the fertile Chuckawalla Valley on the eastern border of San Bernardino County, the Chuckawalla Development Company has been sounding the Colorado River bottom for the purpose of locating a power dam site. R. M. Teague, president of the company, is in active charge of the work.

SAN FRANCISCO, CAL.—The City Electric Company of San Francisco has been bought by the Great Western Power Company, of which Edwin Hawley is the head. The consideration is $4,000,000 or $80 a share for the 50,000 shares of the City Electric Company. The deposit of $150,000, which had been put up while negotiations were pending, has been paid to Herbert Fleishhacker, and the agreement of the sale and transfer of the shares signed.

SACRAMENTO, CAL.—John and Russell Fairbairn, have filed an action against the American River Electric Company to recover $175,000 damages for injuries sustained by them in an accident that occurred on the Middle Jackson road last June. They were moving a derrick when it struck one of the power lines, transmitting the electricity to the two boys.

John was so badly injured that he had to have his left arm amputated, whi e Russell had to have his left arm and right foot cut off. The former asks for $100,000 damages and his brother for $75,000. The accident, they claim was due to poor insulation.

TRANSPORTATION.

TURLOCK, CAL.—S. N. Griffith has applied for a 50-year franchise for an electric road through this city.

LOS ANGELES, CAL.—A petition signed by forty Vernon avenue property owners has been sent in to the City Council favoring a cross town car line on Vernon avenue from Fourth to south of Jefferson street.

FERNDALE, CAL.—Preliminary steps looking to the construction of an electric line to connect Ferndale and vicinity with other parts of the county have been taken, and the results obtained have been most satisfactory. D. A. Francis of Ferndale has been locating the route.

SANTA ROSA, CAL.—The Petaluma & Santa Rosa Railroad made its first move in regard to the proposed extension to McNear's Point by entering into a traffic agreement with the Western Pacific Railroad, whereby the electric is authorized to make through freight rates to and from eastern points.

ANTIOCH, CAL.—That the promoters of the Oakland Antioch Electric Railway intend building the line through to Stockton, and that at an early date, is demonstrated by the fact that their representatives are now at work between Antioch and the Slough City, securing rights of way for the road.

SAN FRANCISCO, CAL.—Sealed bids will be received by the Board of Public Works, at their office, tenth floor, David Hewes Building, 995 Market street, between 2 and 3 p. m., April 5th, 1911, for furnishing and delivering to the city and county a quantity of tubular steel trolley poles for the Geary street municipal railway.

TUCSON, ARIZ.—With a visit of the officials of the Tucson Rapid Transit Company to this city, work on the proposed extension of the street car line from the university gate to Speedway and then down Speedway for about a mile, has been revived. Property owners along Speedway who are backing the project now feel sure that they will succeed in their efforts.

OREGON CITY, ORE.—The Mt. Hood Electric Railway Company is preparing to enter Oregon City and at a meeting of the City Council, application was made for a franchise to furnish heat. The company's representative was accompanied by G. O. Fields, who has been promoting the construction of an electric railway from Oregon City through the Molalla Valley to Silverton.

OAKLAND, CAL.—The City Council favors a 50-year franchise to be given to the Southern Pacific Company from the Sixteenth street depot to the mole for the proposed elimination of what is known as "death curve." The question of a subway or overhead crossing at Seventh street, where the company will maintain four tracks, has been discussed, but no action taken. The railroad company has offered to pay one-half of the cost in either event.

OAKLAND, CAL.—The Oakland Traction Company is planning to inaugurate a new service on the Hayward lines within a short time. The Hayward cars, instead of stopping at Clay and Twelfth streets in Oakland, as now, will proceed down Twelfth street and out Poplar street to Poplar Junction, taking the place of the regular Key Route cars, which have caused congestion on Twelfth street at Broadway. The Hayward cars will be equipped with trailers, to handle the increased San Francisco travel. Upon the assurance of President E. A. Heron, given through Stuart S. Hawley, that with the relieving of the congestion on the East Fourteenth street ines in East Oakland, Fruitvale and Melrose, the company would put on an express service to Hayward, the combined organizations of the Hayward Chamber of Commerce and the Hayward Real Estate Exchange adopted resolutions last night petitioning the Oakland City Council to grant the Oakland Traction Company its desired franchise on East Sixteenth street, known as the old county road, between Thirteenth avenue and High street.

TELEPHONE AND TELEGRAPH.

NOME, ALASKA.—Fire recently destroyed the telephone exchange.

UKIAH, CAL.—H. Olsen has been granted a franchise for a telephone system in First Read District, Mendocino County.

NAPA, CAL.—John A. Carbone has applied for a fifty-year franchise for a telephone system to be erected in Napa County.

MERCED, CAL.—Arthur L. Bruce filed an application for permission to erect a public telephone line in Supervisor District No. 4.

BISHOP, CAL.—G. A. Hanson, who had presented a bid for telephone franchises has been granted permission to withdraw same on his request.

LIVINGSTON, CAL.—E. D. Thomas, president of the Livingston Realty Company, is arranging plans and purchasing material for Livingston's telephone system, of which Mr. Thomas is projector.

OROFINO, IDAHO.—Sampson Snider, manager of the Clearwater Telephone Company, announces that he will immediately begin the construction of a telephone line to serve the Elk river district.

McMINNVILLE, ORE.—The McMinnville Mutual Telephone Association has asked for a 25-year franchise for the purpose of installing a local telephone system. This will also be connected with long distance telephones.

BUTTE FALLS, ORE.—The office of the United States Forest Service has forwarded recommendations to the district forester for the installation of a telephone line from this place through the Prospect country, to cost approximately $2200.

ELKO, NEV.—F. H. Winter, A. Z. McCloy, C. S. Andrews and E. C. Murray, all of Jarbridge, Elko County, Nevada, have made application to the Board of County Commissioners for a franchise to install a telephone line and operate the same for 25 years from Jarbridge to Deeth.

PALOUSE, WASH.—The Interstate Consolidated Telephone Company will erect a building here and establish a modern phone service in this vicinity this summer. It is understood that the company will string wires to the principal cities and towns in the Palouse district.

SAN FRANCISCO, CAL.—A meeting of the telephone rates committee of the Supervisors was held last week. A delegation of hotel men, headed by Kirk Harris, was present to present their contention of last year that the charge of 25 cents per month being paid by the hotel men for room telephones should be eliminated.

SAN FRANCISCO, CAL.—The officials of the Pacific Telephone & Telegraph Company request that they be allowed to abolish the present four-party residence line, with 30 free switches at $1.50 a month, and substitute a two-party line with 60 free switches at $2.25 per month, maintaining that a better service can be given on a two-party line.

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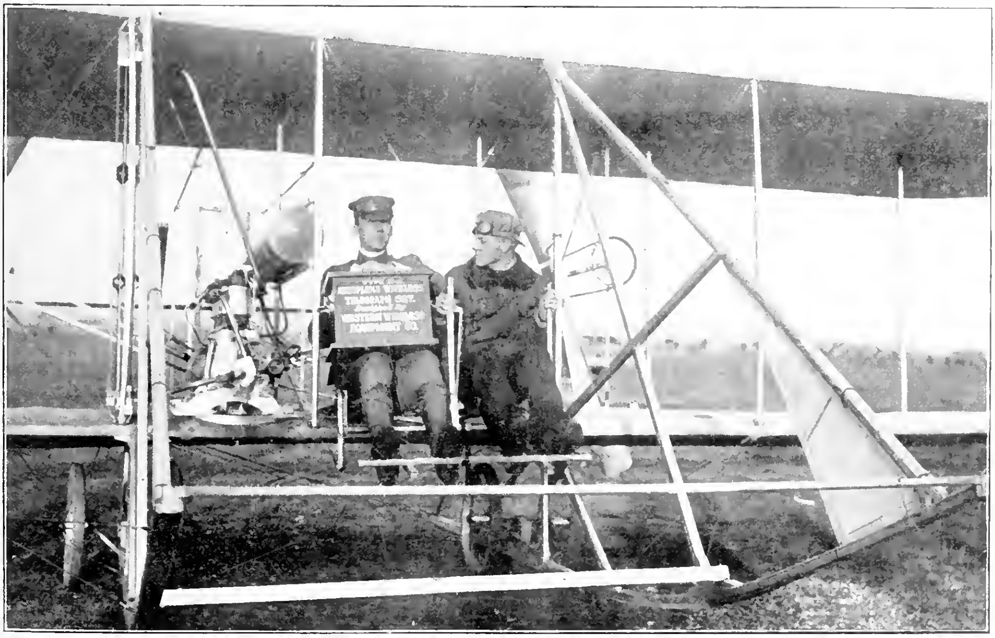
WIRELESS TELEGRAPHY FROM AN AEROPLANE

BY E. E. ENNIS.

Wireless telegraphy as a factor in the aerial evolutions of the future in naval and military warfare was thoroughly exploited in a series of experiments conducted for the War Department at the recent aviation meet at San Francisco. At that time it was conclusively proven for the first time that communication can be established between an aeroplane, hundreds of feet in the air, and a ground station, and that messages can be transmitted with absolute accuracy from almost any distance or altitude with practically no interferences from other wireless stations in the vicinity.

From a military standpoint, the results obtained are invaluable. The chief function of the aeroplane in warfare is along the line of scouting duty, and finds its most important place in reporting the position of hostile bodies of troops, making maps of fortifications, locating guns, supply trains, etc. The facility with which such information can be "wirelessed" to headquarters from an aeroplane circling thousands of feet overhead and practically out of range of hostile gun fire, and the value of such information in governing the arrangement and advance of troops, artillery and fortification construction, makes the wireless the most valuable contribution of the century to the highly advanced science of modern warfare.



Wright Aeroplane Equipped for Wireless Tests.

The tests were conducted at Selfridge Field and were under the direct charge of Lieutenant Paul W. Beck and representatives of the Western Wireless

Equipment Company, who designed and built the apparatus for the experiments. The maximum distance covered was 40 miles and the greatest altitude attained during the tests was 500 feet, at which time Lieutenant Beck, carried as a passenger in a Wright machine, transmitted two complete messages in the Morse code to the wireless station on the aviation field while traveling at an approximate speed of 55 miles per hour. Both messages were received at the field station as well as by other stations, one of which was over 40 miles distant, with absolute clearness and accuracy.

The apparatus used in the experiments was a radical departure from the generally accepted design and embodied many unique ideas in construction and operation. The entire sending instrument, which Lieutenant Beck carried in his lap, weighed but 29 pounds and was enclosed in a small mahogany case with sending key fastened on the top. In constructing the apparatus, cognizance was taken of certain physiological phenomena originally discovered by Professor Fessenden, i.e., when a spark is used which gives a high-pitched musical note, the ear becomes more acutely sensitive to its presence and it can be distinguished at much greater distances than sparks of a lower frequency. The transmitting end was therefore tuned to the highest possible frequency, which gave the set a certain degree of selectivity and eliminated to a great extent the disturbing impulses of extraneous interferences.

The integral instruments consisted in the main of a small storage cell, a high-frequency coil-transformer, an inductive transformer for syntonizing, variable condensers for varying the capacity of the oscillation circuit, a noiseless discharge chamber for the spark and an ordinary telegraph key. The antenna consisted of 95 feet of phosphor-bronze wire, 1/16 of an inch in diameter, formed of seven fine strands inter-twisted and weighing 1½ ounces. When the aeroplane left the ground this was wound around a small drum which unwound at the will of the operator and swung out behind, clear of the propeller. The wire was fastened to the machine by a simple clip attachment, that was easily opened when the aeroplane neared the ground, releasing the antenna and allowing it to drop to the ground, and permitting the machine to land free from possibility of entanglement with tree tops or other objects. The transmitting instruments were properly balanced with the antenna both as to capacity and inductance, before the aeroplane left the ground.

For a ground connection a capacity ground was substituted in the form of the wire stays of the aeroplane. This was found to have ample capacity to act as a counterpoise to the antenna. The strange feature of the demonstration was that at all times the ground was actually higher than the antenna, which is the direct reverse of all other wireless work, where a certain height of the antenna above that of the ground is desired, and which under ordinary conditions is almost imperative. Another point that was noticed was that the higher the aeroplane went the clearer the signals became, which seems to bear out Tesla's theories that stationary waves exist in the earth, the disturbance of which by even minute currents produces extended effects, and that at the altitude of a mile or more above the actual surface of the earth, the globe could be practically belted by wireless waves with comparatively little power.

The steady decrease in the loudness of the signals as the aeroplane traveled away from the field station and the correspondingly steady increase as it returned indicates that with a receiving instrument on the ground properly calibrated and used in conjunction with a sensitive galvanometer and a Wheatstone bridge, it would be quite possible to determine the approximate distance of an aeroplane from a ground station. This would be specially valuable in locating hostile machines communicating with their own troops, especially if used in connection with a directive system like the Belli-Tosini, which is able by the use of an instrument called a radio-goniometer to determine the compass direction of a station in operation.

Merely tentative efforts were made to receive a message aboard an aeroplane during the tests at Selfridge Field, owing to the practical impossibility of hearing any of the signals through the terrific exhaust of the engine. The aeroplane is in its crude state yet, and until the noise is eliminated it is impossible to receive signals from the ground and have them audible in telephone receivers even though as sensitive a detector as the perikon is used. Until such time as a degree of quiet can be obtained in aeroplane motors it will be necessary to use some form of mechanical receiver of the tape or galvanometer type, tuned to the same group frequency as the radiating circuits of the sending station. This could probably be developed to a successful point with the proper experimentation.

Wireless work as applied to aeroplanes is capable of much greater development than as applied to any other field of research. The ability to obtain an almost unlimited wave length, and absolute freedom from interference, added to the small amount of power necessary to reach unbelievable distances, all open up a vista to aeroplane wireless that is as free from limits as the medium through which it works, and will undoubtedly lead to the clearing up of many of the contradictions that hamper the progress of the experts

PHANTOM TELEPHONE CIRCUITS.

BY W. R. PATTON.

Probably one of the most valuable developments of the telephone art as applied to long distance service is the system of providing a third circuit known as the phantom circuit, from two existing metallic circuits, without stringing additional line wire. Extravagant claims are sometimes heard, both for and against the practical efficiency of this class of circuit, and it is possible that a number of employes do not understand its true characteristics.

The so-called phantom circuit is a real, metallic circuit in which each of its two conductors is formed by the two wires of a physical circuit connected in parallel. It requires definite line construction in pairing and transposing the physical circuits, and the two wires of the side circuit must be considered both as to their fitness for service in the single metallic circuit and for service as one side of the phantom circuit. The effect of poor line conditions is much more serious upon a phantom circuit than upon a side circuit, on

account of the double leakage of the four wires and the greater chance for unbalanced insulation. Also, the effect of line trouble is much more serious in this double use of the line wires. However, any improvement in line conditions or maintenance efficiency necessary to make the phantom circuit reliable, would probably not increase the maintenance cost per talking circuit because of the increased number of circuits.

Any noise experienced on phantom circuits is subject to practically the same kind of treatment as that employed for noises on the side circuits. A wire chief's careful test of the phantom circuit will discover any defects or unbalanced conditions, and the remedy. Probably the most frequent cause of noisy phantoms, and the most difficult to handle, is inductive disturbance from paralleling lines of the various power companies. This disturbance is often serious on the phantom circuits when it is scarcely noticeable on the side circuits. In some cases it can only be eliminated by increasing the distance between the telephone lines and the power lines, but obviously this most expensive remedy should not be applied until after all other means have been exhausted. Unbalanced conditions either in the power company's circuit or in the two side circuits of the phantom are usually easily discovered and remedied. The effect of the induction may be sufficiently reduced by this means, or possibly by a rearrangement of the circuit layout. In one case a phantom circuit about 100 miles in length was cut in two, making one of seventy miles and one of thirty miles. This confined the disturbance to the thirty-mile section, and its effect upon this short phantom was found to be very slight and the phantom was put into regular service. The seventy-mile phantom was connected to the physical circuit which was released by the installation of the thirty-mile phantom, thus completing the original 100-mile circuit and avoiding the inductive disturbance.

In emergencies it is sometimes possible to provide a temporary phantom circuit under conditions which theoretically would appear prohibitive. When an additional circuit is needed on short notice, it is usually advisable to make practical experiments to ascertain whether a phantom can be obtained. Often a slightly noisy circuit which could only be used by operators for passing calls would be of benefit. Such a circuit can be provided very quickly in certain cases, by using the telegraph leg of a simplex circuit as a grounded phantom circuit.

With the type of loading coil heretofore employed, it has not been possible to operate the phantom system over loaded circuits. To overcome this limitation, the American Telephone & Telegraph Company's engineers have recently invented a new type of loading coil which permits not only of the operation of the phantom system over the loaded circuits, but also of applying the loading coil system to the phantom circuit. Thus by a combination of the phantom system and the loading coil system, a circuit can be provided at very low cost which will furnish a range of transmission greater than that of the loaded physical circuits. Both of these systems are now applicable to the largest circuits in commercial use (No. 8 copper, 435 pound) and the range of commercial transmission will therefore be appreciably extended.—Pacific Telephone Magazine.

RADIANT ENERGY AND MATTER.[1]

BY SIR J. J. THOMSON.

To every inhabitant of the solar system, whether resident on the earth or on Mars, the subject of radiant energy is one of vital importance. The planets are not living on their own resources. They are dependent for their energy from day to day, almost from minute to minute on the supplies they receive from the sun. The solar system is really a power distribution scheme on an enormous scale, and the sun is the power station. The method by which the power is transmitted is practically wireless telegraphy, because there is every reason to believe that radiant energy travels from the sun in the form of something mechanically equivalent to electric waves. Practically all the power used for the purposes of the world's work has come from the sun.

The magnitude of the energy sent out from the sun is larger than many people realize. Measurements have shown that on a clear sunny day the sun transmits to the earth energy which corresponds to about 7000 h.p. per acre. At present all that is practically wasted, or rather it is spent in making the earth a little warmer, generally in localities where any addition to the temperature could well be dispensed with. Attempts have from time to time been made to utilize this enormous supply of energy, but not with any great measure of success.

At the last meeting of the British Association an account was given of an experiment in this direction, which was being made in one of the hot districts in the United States, to transform the heat of the sun into work by means of low-pressure turbines. That experiment has shown that it is possible to obtain from the sun energy at less than half the cost of the cheapest power hitherto available. There is no doubt that in the sun there is a supply of energy to fall back upon when coal gets dear and water-power is all used up. Only about three-fifths of the energy sent to the earth from the sun is appreciable to the eye as light. If the sun were twice as hot as it is, four-fifths would be appreciable in that way, and if it was still hotter the whole of the energy would affect the eye as light. Radiant energy is not heat: that is, the energy of the sun does not reach the earth in the form of heat. It is not heat at all until it falls on bodies whose temperature can be raised. It might rather be called electricity; in fact, I believe it is a form of electricity, for all the methods used to detect and measure radiant energy depend upon absorbing it and transforming it into heat.

Professor Boys has produced an instrument for measuring the heat radiated from various bodies, which is so sensitive that he can detect the radiation of heat from a candle at the distance of a mile.

Applying to the sun the law that the energy radiated from any physical body is proportional to the fourth power of the absolute temperature, we find that the heat of the sun is about 6000 degrees. At that temperature the amount of energy radiated is something like 15,000 h.p. for every square centimetre of the sun's surface, an appalling amount in the aggregate when the area of the sun's surface is taken into account.

[1] Abstract of a paper read at the Royal Institution, March 4, 1911.

OIL BURNING.

BY E. N. PERCY.

The world's fuel production in 1909 was 1,084,000,000 tons of coal and 40,000,000 tons of petroleum, the calorific equivalent of the petroleum being 60,000,000 tons of coal. In other words, exclusive of wood, it consisted of 108 parts of coal and 6 parts of petroleum in calorific equivalent value. Of this the United States produced 444,000,000 tons of coal and 24,000,000 tons of petroleum, the calorific equivalent of the petroleum being 36,000,000 tons of coal. California produced practically no coal. The average value of the coal in the United States was $1.31, the average value on the Pacific Coast was $4 and for California $6. In 1910 California produced 13,000,000 tons of petroleum, the calorific equivalent being 19,500,000 tons of coal. Practically all of this oil has been sold and the rate of increase in consumption is greater than the average rate of increase in production, the latter being erratic because of the development and subsequent decline of gushers.

At the present time petroleum is being developed in almost all parts of the earth and the general conclusion is that oil fuel is a permanent and growing factor in mechanical engineering. It is hard to approach the subject of oil burning without considering it in the broadest sense to include all departments from gasoline carbureters to the Russian Astatki burners.

At the writing of this article there lies before the writer a pile of patent records five inches high. They include all patents issued in the United States for oil burners. The individual inventor usually repeats the history of oil burners in the process of his education by experience. The first efforts and ideas are usually along the line of vaporizing burner, i.e., a burner which is heated by its own flame or otherwise, with a view to vaporizing or gasifying the oil, a system that has long since been discarded for two reasons, one chemical, the other practical: First—Any fixed gas contains a less percentage of carbon than liquid hydrocarbons, further in gas formation it is necessary that free carbon be deposited. Second—This free carbon clogs the burner to an objectionable degree.

The next step is usually along the lines of atomization, and the inventor goes into the construction of immensely complicated apparatus to accomplish it. This work is frequently characterized by an amazing ignorance of the fundamental properties of oil, also of the wide difference between various kinds of oil. We will give here a chemical definition of the principal oil classifications, the details of which may be easily found in any text book on chemistry.

Paraffine oils may be classified, first as those containing $C_nH_{2n} + _2$ up to $C_{28}H_{58}$ (Pennsylvania, West Virginia, Kentucky, Kansas, Colorado, etc.), and second, those containing $C_nH_{2n} + _2$ up to $C_{11}H_{24}$ and above that $C_nH_{2n} - _2$ (polymethylenes, Ohio and Canada).

Cyclic oils contain, first, stable polymethylenes consisting largely of napthenes C_nH_{2n} (Russia), and second, less stable polymethylenes with unsettled hydrocarbons with nitrogen and sulphur compounds leaving an asphaltic residue on distillation (California).

Asphalt is a compound of cyclic hydrocarbons which are attacked by sulphuric acid. Paraffine is not readily attacked by sulphuric acid.

It is difficult to obtain unbiased data from recognized authorities on oil burning because each authority, as a rule, has some private system or apparatus to exploit.

The vaporizing system of burning oil has been quite generally abandoned, not only in oil burners, but in gas making apparatus and gasoline engine carbureters, for the same reason in each case, that the oil is not completely burned, an objectionable residue being left. The easiest oils to burn, mechanically speaking, are the thinnest, as they are more easily atomized. Oil in bulk has a cohesiveness which resists any atomizing action. Furthermore, as the oil is broken up into large drops, each drop develops a surface tension which is much greater even than cohesiveness. Surface tension is a force seldom considered by those who have studied the subject of atomization.

The writer has seen drops of water floating in oil which was boiling at a temperature of 300 degrees Fahrenheit. As the corresponding pressure of steam at this temperature is 100 pounds and as it is obvious that nothing but surface tension would have held these drops intact, the work necessary to overcome this tension can be appreciated. It is the writer's firm belief that any system of atomization should proceed as nearly as possible from the bulk condition to the ultimate atomization without allowing the formation of intermediate spherical drops and their attendant surface tension which has to be broken up. He is also inclined to believe that this explains the reason for the superior economy of burners having a single stage of atomization as compared to multistage types.

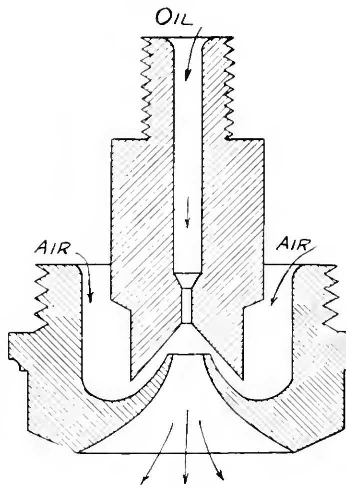


Fig. 1.

During the development of the Priestman oil engine many types of atomizers were tried and the one finally adopted was that shown in Fig. 1. This is clearly a single stage atomizer and has been found most satisfactory, although, to the writer's knowledge, the principle of a jet of air impinging directly opposite the stream of oil has never been utilized in oil burning.

Various principles are used to effect atomization, including mechanical methods, centrifugal force and

direct battering by means of steam or air, the last being in most general use.

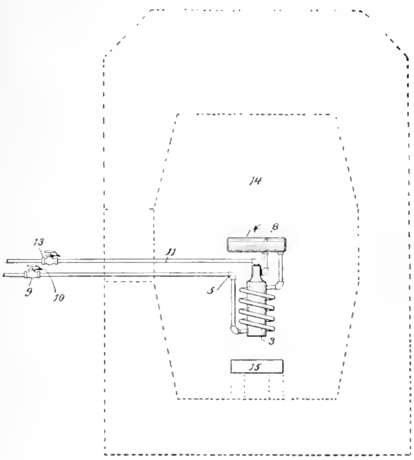


Fig. 2.

Referring again to the earlier types of burners and furnace arrangement we have in Fig. 2 a burner designed to go inside the furnace and vaporize the oil to a gas before burning; it has never come into general

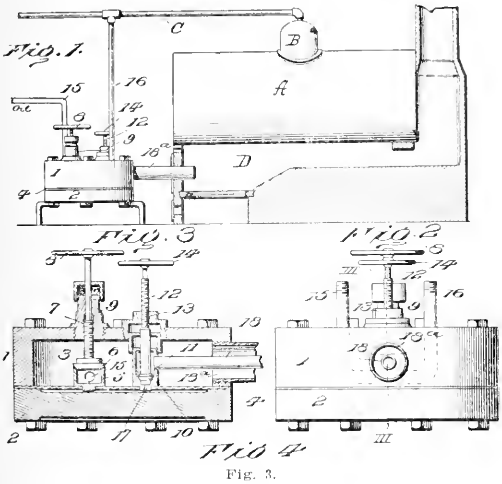


Fig. 3.

use. Fig. 3, of inconvenient size and complication, has never come into general use. Fig. 4 shows another of which the same might be said. These are given simply as illustrations of the impracticable form of some of the early types of oil burners.

Probably the earliest and most complete experiments in the oil-burning line were made in Russia in the attempt to apply the Russian Astatki to power and industrial purposes. Fig. 5 shows one of the earliest and simplest burners used for that purpose and said

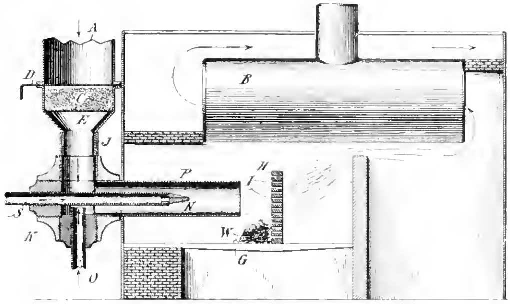


Fig. 4.

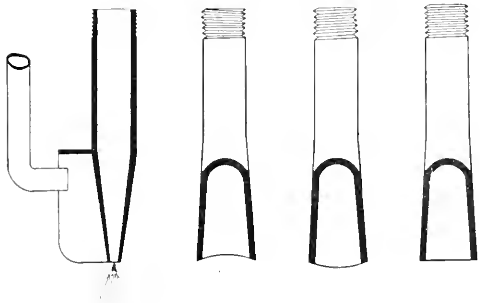


Fig. 5.

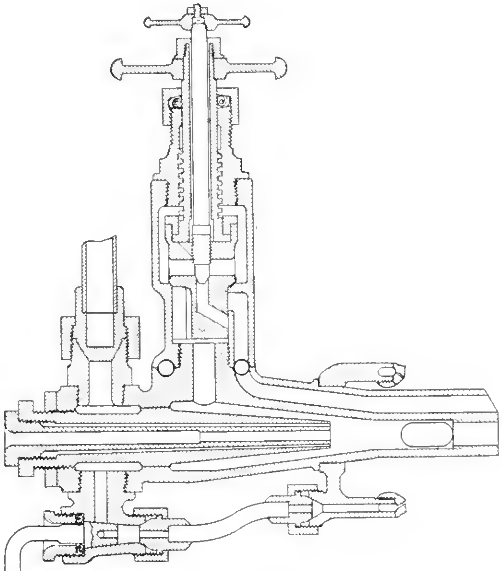


Fig. 6.

to be highly successful. Fig. 6 is an excellent illustration of the Holden burner, which was applied for many years, with great success, to locomotive work.

Fig. 7 shows one of our earlier California burners and has been used to quite an extent.

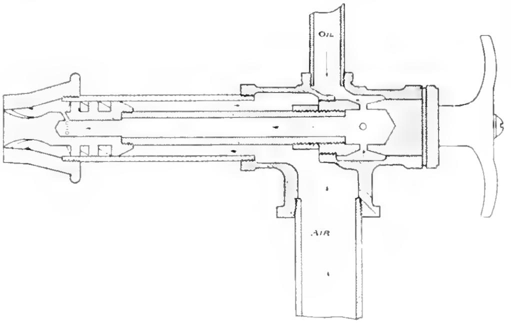


Fig. 7.

Fig. 8 is an illustration of the centrifugal method of atomization which has been quite successfully exploited by several firms. The atomization usually

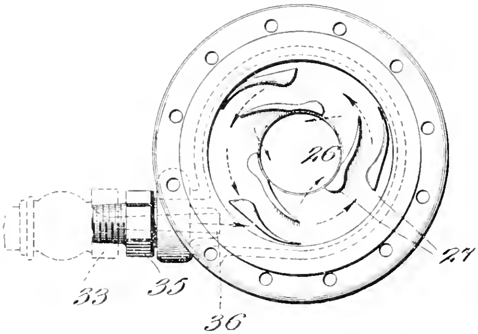


Fig. 8.

takes place in the central chamber, from which pipes lead to the various burners. Fig. 9 illustrates a method

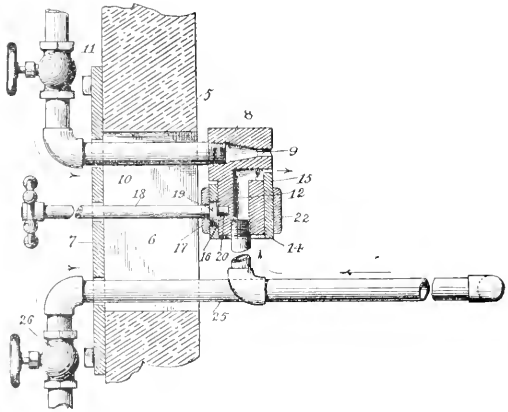


Fig. 9.

of superheating the steam, a method which is used by many engineers, a patent for which has evidently been granted to someone.

Fig. 10 shows a siphon burner which has been more or less developed by several inventors, the object of which is to comply in the first place with the Underwriters' disapproval of gravity oil systems and in the second place to eliminate the oil pump.

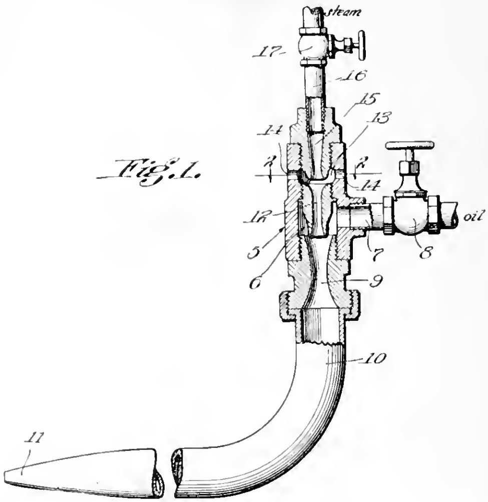


Fig. 10.

As said before, a certain amount of work is necessary in order to atomize oil properly. This work may be partly done by the mere application of heat, which reduces cohesiveness and surface tension, namely, in reducing the viscosity. But this viscosity consists of two factors in no wise dependent on each other. They are, in the first place, cohesiveness, and in the second place, surface tension or adhesiveness. There are no experiments which have supplied data as to the theoretical amount of work necessary for the atomization. The indications are that it is less than 1 per cent of the thermal power in the oil, but must in any case be a variable quantity.

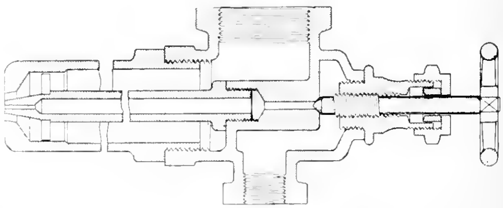


Fig. 11.

Fig. 11 shows an ordinary round flame outside mix burner, in which the oil going into the smaller pipe passes through the central pipe and the air entering the larger passes around the orifice. The oil is regulated with a hand wheel. This particular burner is designed for low pressure and is of 2, 4, 8 lb. pressure. Such a burner is trimmed first by increasing or decreasing the diameter of the inside pipes to suit the air pressure, second by increasing or decreasing the oil

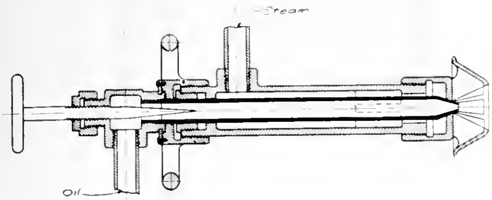


Fig. 12.

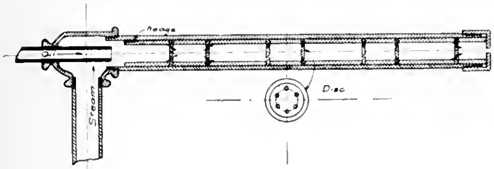


Fig. 13.

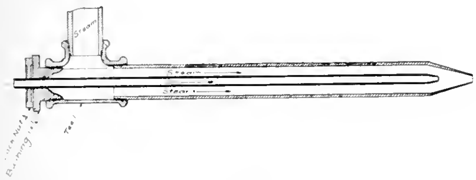


Fig. 14.

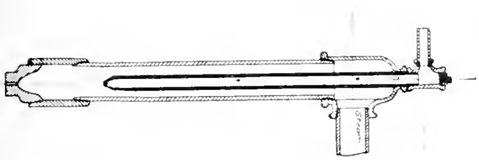


Fig. 15.

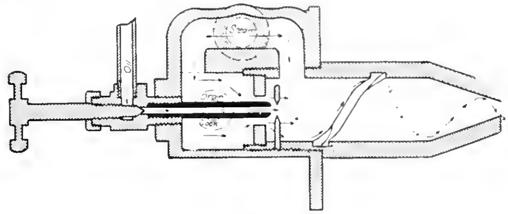


Fig. 16.

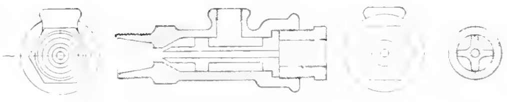


Fig. 17.

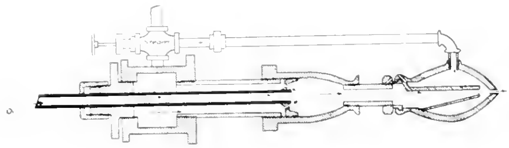


Fig. 18.

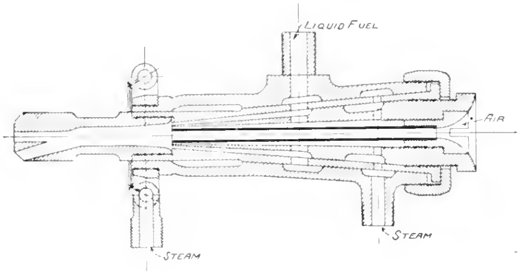


Fig. 19.

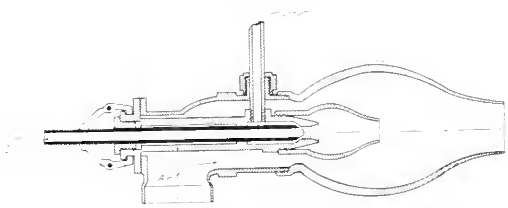


Fig. 20.

hole to suit the oil pressure, third by extending the inside pipes outwards to increase the length of the flame or inwards to decrease the length of the flame and widen it.

Fig. 12 shows a burner of the same type but equipped with a hand wheel whereby the inside pipes may be moved and the length of the flame controlled at will. Fig. 13 shows a similar type of inside mix burner made from pieces of pipe and iron washers; such a burner will atomize splendidly, making a broad flame close to the burner, but will soon clog and has no possible means of cleansing except complete taking down. Therefore such a burner makes a flame so broad and close that it burns off the corners of the square head.

Fig. 14 shows a pipe burner of popular type that always gives fair satisfaction if carefully made. Fig. 15 shows another type of pipe burner. Fig. 16 is an inside mix with special curve giving a rotary flame; it is intended primarily for Scotch boilers. Fig. 17 is another type of round flame burner made to fit into a gas shell, iron smelting furnace or other iron shell. Fig. 18 is a multistage burner often used. Fig. 19 is another type of the Holden burner; its best use is to illustrate the complications that are sometimes introduced to accomplish results equalled by much simpler apparatus.

Fig. 20 is a round flame of the combined type using both steam and air from a blower. The idea of this type of burner is that the amount of air necessary for the combustion issues from the burner with the oil. The result is an intense combustion close to the

burner and there are many cases where this is desirable. Fig. 21 shows a well known flat flame burner

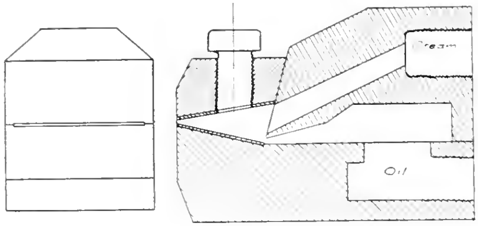


Fig. 21.

which is much used in back-shot furnaces to be described later and is held in high regard by some engineers.

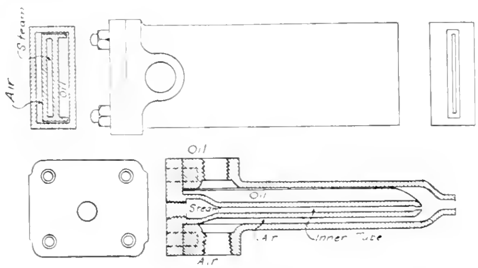


Fig. 22.

Fig. 22 is what is popularly known as the Southern Pacific burner, a flat flame type, and while lacking some points of refinement in the eyes of many engineers is said to be highly satisfactory. Fig. 23 illustrates still another form of flat flame burner.

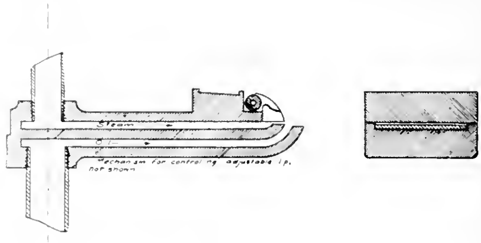


Fig. 23.

Several authorities have gone deeply, both practically and theoretically, into the subject of furnace arrangement and construction. The concensus of opinion seems to be that while it is desirable to have white hot brick all around the flame, it is impracticable in many cases to do so, and a compromise is effected by using a flat flame, burning close to a white hot brick floor through which the air rises steadily through the flame. It may be taken as a first principle of oil combustion that the air must pass through the flame.

Fig. 24 shows nine ways of trimming a flat flame oil fire. In 1 the burner is not wide enough and the bricks have entirely too many spaces for draft. In 2 the flame shown will burn fairly well with the draft holes as shown, but the capacity of the burners can never be completely realized until the draft holes are made longer and the shell in the burner lengthened.

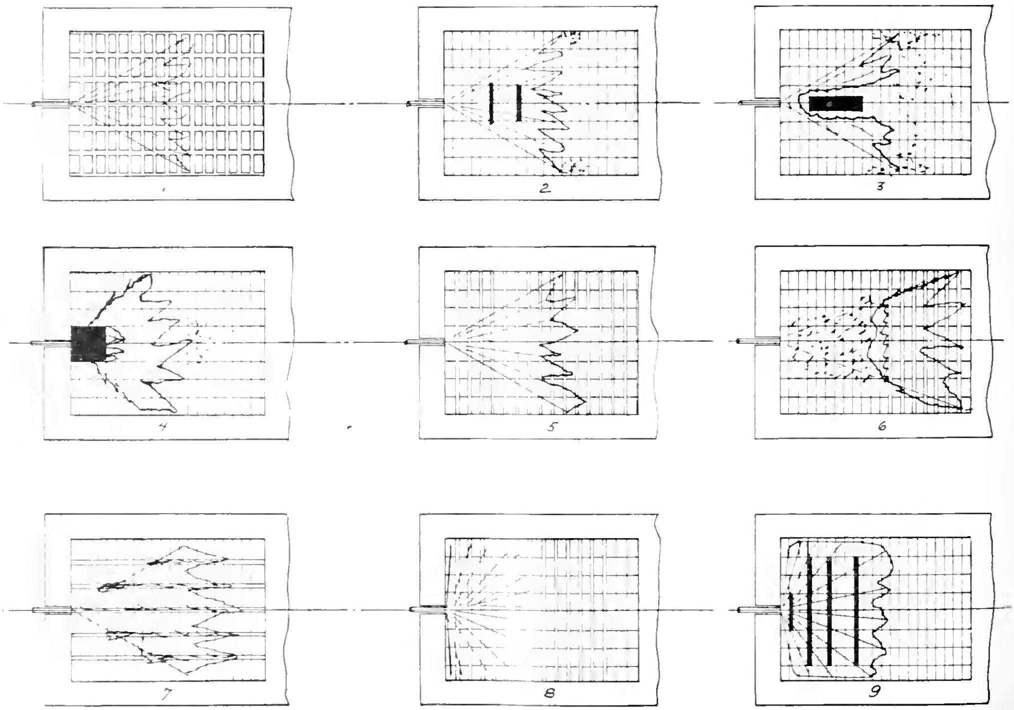
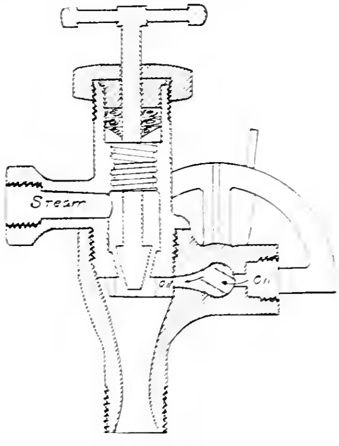
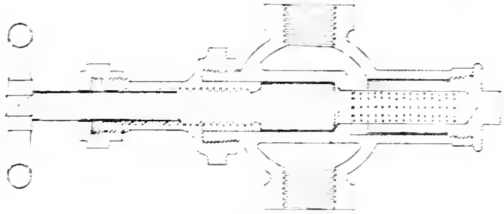
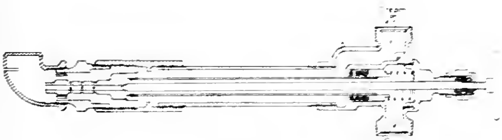


Fig. 24.







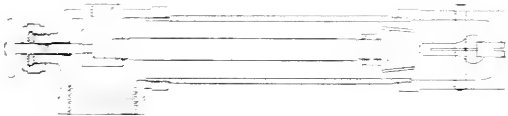
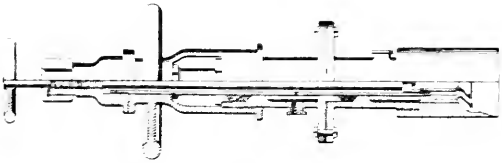
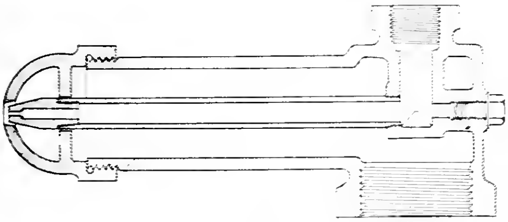


Fig. 11.





Nos. 3 and 4 show the probable action of a flat flame if the air was admitted in the manner indicated. The same comments that apply to 3 would govern Nos. 5 and 8 excepting that No. 8 is trimmed broad enough but has too many draft spaces. In 6 the draft spacing is too far from the burner and the carbon would be deposited between the burner and draft holes. No. 7 illustrates that longitudinal draft holes are not as good as cross-wise. No. 9 indicates the correctly trimmed burner with correctly placed draft holes. Most engineers make the mistake shown in [illegible] by having the flame too narrow and admitting air around the shoulders where it cannot get through the flame. Such a fire shows an excess of air no matter how the ashpit doors are regulated, even when the fire is smoking.

[illegible] a burner [illegible] Figs. 2[illegible] and 27 sh[illegible] well known types of [illegible] burners which are widely used. Fig. [illegible] low pressure round flame burner of the [illegible] with a regulating valve.

[illegible] a popular type of regulating valve [illegible] burner having in the first place a [illegible] strainer, in the second place a part for [illegible] shut down [illegible]. The [illegible]

[illegible]

entire cutting out of one or more boilers when the load is low and vice versa when the load is high. The other method consists of what is known as central control, whereby the oil pressure in controlled from one point for all fires. This control may be either by hand or automatic and there are patented systems covering each method.

Considerable automatic apparatus is necessary in oil firing. If siphon burners are not used a pump must be furnished, usually of the simple duplex type. It has often been necessary to equip it with an automatic governor for maintaining constant oil pressure. The heater is made in many forms, either the casting throughout or a coil of iron pipe with return ells, or a piece of copper pipe especially coiled for the heater.

The specific heat of petroleum varies from .4 to .5 and according to various authorities 20 to 40 lb. of petroleum per hour can be heated 1 degree F. for each degree of difference between the temperature of the steam and the average temperature of the oil per square foot of heating surface.

Two systems of oil piping are in general use, one in which the oil is pumped directly to the burner and into the fire, the other in which the oil is pumped constantly through a circuit of pipe and returned to the pump suction, the burners being inserted anywhere in this circuit; the heater being cut into the circuit next to the pump on the discharge. The discharge from such a circulating system should never lead into the fuel tank but to the pump suction only, because it is possible for the main body of oil to gradually become so heated that there will be dangerous evolution of explosive gases, especially with crude or unstandardized oils carrying light fractions.

(To be continued)

An electric copper smelter is in successful operation at Delamar, California

The Board of Public Utilities at Los Angeles has power to investigate public service commissions and establish rates subject to the approval of the Council. By the recently adopted amendments to the charter the city may operate quarries, railroads, elevators, tunnels or viaducts and may supply citizens with any means of heat, illuminating power or refrigeration, selling the surplus to other municipalities.

The Bell report for 1910 shows that the American Telephone & Telegraph Co. has nearly six million stations and twelve million miles of wire in use, and gave a total of over seven billion connections for the year. The gross earnings for the year were $165,600,000, an increase of nearly $16,000,000 over those of 1909. Of this, operation consumed $54,000,000, taxes $8,000,000, current maintenance $25,700,000, and provision for depreciation $26,200,000. The surplus available for charges, etc., was $51,000,000, of which $11,500,000 was paid in interest and $25,000,000 in dividends to the public. The total capitalization is $1,114,310,970, of which $502,306,910 is owned and is in the treasuries of the Bell system and $612,000,000 in the hands of the public.

DISCUSSION ON CONSERVATION.

Conservation was the subject under discussion at a meeting of the Commonwealth Club of San Francisco on March 27, the principal speakers being Frank Short and Theodore Roosevelt.

Mr. Short's Speech.

"Upon this occasion, with ten minutes at my disposal for the purpose of the supposed discussion of a very serious question of constitutional law and civic policy, I feel, in the first place, as though I were a part of the debris that is always assumed necessary to be removed before the real thing is reached upon an occasion of this kind. In referring to the illustrious guest of the evening even indirectly as the 'real thing,' I am not guilty of any originality but am purloining the picturesque language of Governor Stubbs of Kansas.

"I am not, therefore, assuming the position of attempting to speak in contravention of the supposed views of the guest of the evening, but as a country lawyer, as a humble citizen am merely accepting an invitation to indulge in that honored and remaining right of every American citizen, no matter how obscure, to express his views upon any public question. Obviously, I can no more than attempt to hit a few of the very high places in connection with this much discussed and vitally important question. The real question is whether or not as a matter of law and of right and of policy the conservation, disposition, regulation and control of the remaining resources of the country should be undertaken and carried on by the National Government or by the respective States within which such resources are situated. It has been assumed and most earnestly urged, and in many instances with great sincerity I think, that this function of conservation carrying with it upon the part of the National Government large and additional duties and powers of regulation and government in connection with the resources of the several States and the people of such States can be carried out efficiently and to advantage only by the National Government. And it being assumed that the National Government can most advantageously and efficiently carry out these functions it is assumed rather than attempted to be established that it has the legal power and authority so to do. What I now hold to be true for all time, and you will agree with me some day, is that that branch of the Government that under our constitutional system is designated as the one having authority is the only branch of the Government that can conserve the resources or advance and protect the rights of the people or do real and permanent justice in any way. It has been asserted and reiterated, and the assertion certainly sounds good, that 'the remaining resources of the Nation belong to all of the people of the Nation' and are to be held, operated and used for their benefit.

"Assuming the best of faith in this assumption, I would not recommend any one to become really excited about it.

"If, however, we could indulge in the assumption that sufficient income and revenue can and will be derived from the remaining resources of the Nation that after paying for official control, regulation and manage-

ment, and leave a substantial balance for the benefit of the treasury of the Nation and of sufficient extent to reduce the burdens of taxation of one hundred millions of people, allow me to suggest, and ask your candid consideration of the same, that if sufficient income could be realized to meet such expense and leave a balance sufficiently great to reduce the burdens of taxation for the benefit of one hundred millions of people that the ten millions of people from whose industries and resources this income must be obtained would become a trifle stoop-shouldered packing the load.

"As to the observation that 'the remaining resources of the Nation belong to all of the people of the Nation,' the same is subject to two objections. First, the same never was true as a matter of fact or of law, and if the remaining resources of the Nation belong to all of the people of the Nation, there was a time when no one can deny that all of the resources of the Nation belonged to all of the people of the Nation. It was held and decided by the Supreme Court of the United States some seventy-five or eighty years ago that the public lands and the resources connected therewith were held by the Federal Government in trust for the several States and for the inhabitants thereof, to be passed to private ownership and at nominal prices as rapidly as could reasonably be done, to the end that the United States Government might retire from each of the States as a land owner therein as soon as was reasonably possible. These decisions have been reaffirmed, and the relation of the Federal Government to the several States and the public lands therein has been held to be identical, and continues, in accordance with the original decisions, to apply to the later-admitted States and the lands and resources therein.

"It has been repeatedly held that the Federal Government can exercise no governmental powers upon or in connection with the public lands, but that its powers and functions of government were identically the same in each and every one of the States, 'no greater and no less.' That the people of the several States and the localities within which these resources are situated are always better advised as to the value of these resources and better able to provide for their protection, continuation and utilization than any other people, can no more be doubted than the undeniable fact, that they, the people residing in the vicinity, will suffer in a much greater degree than any others by the waste and destruction of these resources. However, I have observed that, having been for a long time engaged in the practice of the law, I speak too much from a lawyer's point of view, and that the majority of the people, whether they should or not, do not enjoy or encourage discussion of questions from a legal point of view. But fortunately we Americans can understand the equities and the moral right and justice of a question.

"The situation can be correctly illustrated by the following statement: Uncle Sam may be assumed to be the father of four sons, and, for the purpose of keeping our history and geography straight, we will name them East, North, South and West. Uncle Sam, being liberal to a fault and mindful of a trust, transferred to his three eldest sons—East, North and South—all of their share in his estate. That all of Uncle Sam's estate pertaining to East, North and South was transferred either to the States or to the people of those States nobody can deny. More especially after their industrious younger brother began to show the real value of his, the left-over, portion of their father's estate, East, North and South began to look with covetous eyes upon the younger brother's inheritance. Finally deep sense of justice and great moral uplift began to pervade the minds of East, North and South (other families have been affected that way), and finally they appeared before Uncle Samuel and said: 'Father, you have been very profligate in the management of your great estate. You have turned over to us and to our children without needful or any restriction the whole of the portion of your estate we can rightfully claim. In the doing of this you have shown great incompetence and have been guilty, we regret to say, of many inequalities, and even frauds, and behold you have sinned against Heaven and in the sight of all men. We can see no way of atoning for this awful offense except that you shall seize, take and hold that portion of the estate that should descend to our younger brother for the benefit of all of your children. And as a further atonement, having shown in the distribution of the family estate to us that you are incompetent and, sad to relate, dishonest, in consideration thereof we will nominate and appoint you the landlord and guardian, without bonds and forever, of all that portion of the family estate that except for this atonement would have belonged to our younger brother, requiring you, however, to see to it with scrupulous care that your elder sons shall receive from the rents, leases and profits of his estate our equal share of the annual income of our beloved younger brother's estate.' Painful as it may seem, these elder brothers seem well nigh unanimous as to this scheme of atonement, and Uncle Sam seems weak and subject to the influences of the majority. History will record, however, that the Constitution broke the will and the elder brothers were charged with the costs and counsel fees.

"Except as all of the people and all of the resources of the country shall be equally taxed for the maintenance of the National Government, the soil and the beneficial resources of each State of the Union are equally dedicated to the use and enjoyment of its people, to its powers and rights of taxation and revenue for the purpose of maintaining State and local government, schools, universities, roads, highways and all of the accompanying necessities of enlightened and progressive people. I am inclined to think with all possible respect that the condition is not one of great difficulty. All that pertains to the common defense and general welfare in an actual sense is for federal control and regulation. All that pertains to the right of local self-government and the local rights, industries and necessities of the people belongs to the several States. If we shall proceed with the design and spirit to recognize these fundamental conditions, neither to retard, but each to accelerate the other, I imagine we shall have little difficulty, but if each is jealous of the other and if each shall reach for more power and try to encroach upon the powers of the other, we shall have no end of discord, but if all of us could accept

the wise counsel of that great American whose capabilities of stating things in true and simple words have made him immortal, we could accept the advice of Abraham Lincoln and avoid all trouble and conflicts by each struggling toward the light and striving to do the right as God gives us to see the light and the right."

Mr. Roosevelt's Speech.

"Mr. Chairman—I want to make one or two notes on the brilliant speech of Judge Short. And at the outset, Judge, when we note the wisdom of the fathers as binding upon conditions which the fathers could by no possibility have foreseen, I want to recall the statement of that wise and witty philosopher, Mr. Dooley, when Thomas Jefferson was quoted on some policy essential to our well-being: 'Thomas Jefferson was a great man, but he lived before the days of open plumbing.' In speaking of the proper attitude which we ought to take in reference to a conservation of our forests and other natural resources, and irrigation, and to the use of electricity in connection with water-power, you spoke of a decision of the Supreme Court rendered eighty years ago, at a time before any human being knew that electricity could be used in connection with water-power or that irrigation was thought of or could have been applied to a single acre under cultivation in the United States, at a time before it had entered the head of any American or almost any man in the civilized world that it was necessary to conserve the forests of the country.

"No man, no member of the bar, or Judge, can have a more profound respect than I have for a decision of the Supreme Court. (Applause.) I respect it as Lincoln respected it—as Lincoln whom you quoted respected it. I do not, however, include in the functions which I attribute to the members of that august tribunal the function of prophecy. If we treated the Constitution as a strait-jacket instead of what the great Chief Justice Marshall declared it to be, an instrument to aid in our growth, we utterly misunderstand the function of the instrument. It would be impossible for this country to grow if it declined to go into any policy rendered necessary by the creation of conditions not merely new but conditions which could not possibly have been foreseen when the Supreme Court decided on some totally different question. The dictum that you quoted, if it was rendered eighty years ago, was rendered even before the homestead act was passed. It was rendered at a time when men like Webster, men like Choate and Everett, still believed that the wise course for the Nation to follow was to sell all its public land in great masses to the highest bidder, take the proceeds and turn everything over to the States in which the public lands were situate. It was rendered before our people had grasped the truth that it was to our interests not to treat those lands merely from the standpoint of revenue, but in the interests of all the people. And when I say all the people I do not mean that each man got 50 cents' worth out of it; I mean in the interests of the people, because it is to the interest of all our people that we shall have a free, self-supporting democracy on the largest scale throughout this Union.

"That decision was rendered before our people, grasping the wisdom of the proper policy to pursue, had decreed that the land should be sold to actual settlers in 160-acre quarter sections on condition that they should be actual residents on that soil.

"If the Nation had power to sell its lands in small parcels on condition that those who bought it should actually reside thereon and till the land, then the Nation has power to sell the land on the condition that the waters running over that land shall be so used that the use shall be in the interest of the whole people and not in the interest of any small monopoly composed of a few people only.

"If the Nation had the right to pass the homestead law and to protect the actual settler against the land speculator, the land monopolist, then the Nation has the right to dispose of the remaining lands in such fashion as to guarantee our people in the future against seeing the most valuable power lying in any portion of these lands from becoming the property in perpetuity of some monopoly. (Applause).

"I listened with very great interest to the parable of Uncle Sam and his four sons, and how brothers East, North and South united to do wrong to the poor West. I was the instrument of that wrongdoing in the case of the reclamation service, and as you listen to the poetry of it I will tell you the facts.

"We passed the reclamation service providing that the waters of the West should be used not for a few speculators, but for the men of the West. We passed that law providing that the Nation should make the initial expenditures—Uncle Sam, out of the portions of the four brothers by the three who were robbers—and then should be reimbursed as far as possible by the proceeds of sale to the men who benefited from it. Not one dollar comes to the Easterner, the Northerner or the Southerner; every dollar is spent in the West, every dollar is spent to build up the small man of the West and to prevent the big man, East or West, coming in and monopolizing the water and the land.

"The appeal is made that in the name of State's rights, the National Government shall not do the duty it is bidden to do under the Constitution. I believe in the fact and not the word; I care for the fact and not for the word. I am for the people's rights. Where the people's rights mean the rights of the Nation, I am for the rights of the Nation; where the people's rights mean State's rights, I am for the State's rights.

"I do not agree in all points with Arizona's Constitution, but I am against the Eastern men who seek to keep Arizona out of Statehood, because I believe that Arizona has the absolute right, so long as her Constitution is in accord with the Constitution of the United State, to make that Constitution in any way she chooses. And I am championing the admission of Arizona against the majority of the Senators, and I suppose the members from the East. On that point the East is wrong, and I am with Arizona against the East.

"We are asked in the interests of State's rights to have the National Government surrender its control over the lands. Surrender it to whom? To the people of the States? Not at all. Surrender the Alaska

lands to whom? To those magnificent Alaskans, the Guggenheim syndicate of Colorado and the Morgan syndicate of New York? (Laughter and applause). And in the name of State's rights, of local self-government, I am asked to agree to turn over the greatest asset that Arizona has to capitalists in Denver and in New York.

"I will give you another instance and I could multiply them indefinitely. Out in Denver last year I struck this same question as to whether the United States had any moral or legal right to interfere with the use of great private corporations, the acquirement in perpetuity by great private corporations of the right to use the power generated by streams flowing across the national domain. And I heard precisely the argument, Judge, that I have heard tonight, the argument that we must not interfere with the local self-government of Colorado; that we must leave Colorado citizens alone. But who do you think the Colorado citizens were? One man was from Ohio and two from New York.

"Great organized capital nowadays never has a merely State function. Organized capital goes into all the different States. Where the State can deal with it best I want the State to do it; where in the interests of the people of the State the Nation can deal with it best I want the Nation to do it. And where, as in California, I believe that the situation can be satisfactorily dealt with only by the heartiest and fullest co-operation between Nation and State I wish to see that co-operation secured and I wish to see them act in unison.

"But I have not yet quite finished with the three bad brothers. I have expected to enjoy this dinner, but not so much as I am enjoying it (laughter). As I understand the chief point of iniquity in the act of the aforesaid brothers was that in their entire corporate capacity they had asked Uncle Sam to help preserve his heritage for the fourth brother—not for the other three, but for the poor fourth brother.

"In the irrigation service we were making a totally new departure. I was trying to get that scheme of irrigation service put through. No Western Congressman or Senator dreamed for a moment that it would be possible to get it put through on the idea of making the National Government pay for it all.

"No State government was taking any effective steps because it could not take any effective steps to develop the irrigable land. Just as with the forests. New Hampshire wants its forests preserved, but the State has never preserved them. The Nation can step in and do it because the Nation can act not only for New Hampshire, but for the States in the watershed of the rivers in New Hampshire. The Mississippi basin drains half the States of this country.

"Not only does the National Government have to step in as between the States, but during my administration it twice had to step in and deal with foreign powers, once with Canada in connection with the St. Mary's and Milk River irrigation projects and once with Mexico in connection with the irrigation projects of the Rio Grande in New Mexico.

"Here in California that is only true of the southern part of the State, the part affected by the Colorado River. Most of your rivers are intrastate rivers.

"And let me point out this fact, that I have never heard the most rigid defender of State rights insist that the Federal Government should not improve the Sacramento because it was an intrastate stream.

"You spoke of the question of the control by the Federal Government of the electrical power in the waters running over the national domain. As regards that I can do nothing more than to refer you to the legal argument advanced by Judge Lindley, an argument which I regard as absolutely unanswerable, and to the legal and ethical argument advanced by Mr. Wheeler. And it seems to me, Judge Short, that I have already answered that question when I quoted to you the provisions of the homestead law. If we had a right to dispose of the land—not absolute but on condition that certain requisites are complied with, doing that in the interest of the democracy as a whole, we have a right to dispose of the land with a proviso as to the use of the water running over it, designed to secure that use for the people as a whole and to prevent it from ever being absorbed by a small monopoly.

"I regard as the vital principle the principle of not parting with the property; the principle of keeping it in the public hands so that at the end of the next forty or fifty years of national development the people shall have it in their possession and shall not find that they have developed a small number of wealthy men who own something that the public can no longer get except by revolution.

"Now I have struck the crux of my appeal. I wish to save the very wealthy men of this country and their advocates and upholders from the ruin that they would bring upon themselves if they were permitted to have their way. It is because I am against revolution; it is because I am against the doctrines of the extremists, of the Socialists; it is because I wish to see this country of ours continued as a genuine democracy; it is because I distrust violence and disbelieve in it; it is because I wish to secure this country against ever seeing a time when the 'have-nots' shall rise against the 'haves'; it is because I wish to secure for our children and our grandchildren and for their children's children the same freedom of opportunity, the same peace and order and justice that we have had in the past."

Manufacture of gasoline from natural gas has been so successful on a small scale that eight large gas compressors have been ordered by an oil company in the Midway district near Bakersfield, California.

A wireless pipe locator has been devised to show the exact situation of underground iron pipes, without unnecessary digging. The apparatus, consisting of a special head telephone receiver and detector coil, is said to pick up the electric waves produced by passing an electric current through the pipe and thus show its position.

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POWER AND GAS

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E. B. STRONG, President
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C. L. CORY, Secretary.

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B STRONG
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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity Power and Gas." Weekly

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Alameda Electrification

With the date of this issue, it has been given out that the Southern Pacific will inaugurate the electric service on its Alameda local lines. This does not mean that regular service will be started, as it is not expected that the train crews will be sufficiently expert in handling the new equipment for at least two months. Test cars will be run over the lines of the Alameda section, operated by experts, who will give instruction to the regular men.

The thousands of people who daily depend upon the local lines for transportation to and from San Francisco, have waited long and patiently for the innovation, enduring the antiquated steam service, while occasionally there has been bitter complaint at the great length of time consumed in making the change.

People do not appreciate the enormous detail in a change of this sort, where the entire system must be practically rebuilt and re-equipped, together with the solution of the economic question of power supply.

The system might have been completed in less time but at the sacrifice of thoroughness. This all important matter, on which depends not only the safety of human life, but class of service eventually given, has undoubtedly received the consideration it deserves, and we may soon point with pride to the new system with the same gusto that our friends in Los Angeles do to the splendid interurban service centering in that city.

Multiplex Telephony

Much interest has been created by the multiplex system of telephony which Major Squier of the Signal Corps patented and presented to the public. The theory is so interesting and the inventor's action so unselfish as to excite the greatest admiration for this man, who has earned an undying place in the halls of fame. But as to the commercial feasibility of thus superimposing fluctuations of voice frequency on high frequency wave carriers, there seem to be several practical obstacles. These high frequency carriers, which must necessarily be above the range of audition, are attenuated with extreme rapidity, so that for a given volume of sound at the receiving end much more energy has to be put into the line at the sending end at high frequency than when under normal operation. Furthermore, the difficulties from cross-talk with high frequency are much greater than with a low frequency system. Lastly, even with a big difference in the frequencies employed it is next to impossible, even with efficient tuning circuits, to prevent interference between the outgoing current at one frequency and the receiving circuit at the same end of the line tuned for another frequency. This follows from the fact that on a long line the receiving apparatus, even though sharply tuned, must be very sensitive; also, as a very considerable amount of energy at the sending end would be required to produce com-

mercial volume at the distant end, the outgoing current would produce forced effects in the tuned circuit at the same end of the line. This is the same trouble which has so seriously limited attempts to tune wireless telephone systems so as to send and receive a large number of messages simultaneously within a limited area.

Water Power Locations

A measure which will be of great interest to locators of water rights and have important bearing on the future of hydroelectric development in California, is embraced in Assembly bills Nos. 735 and 788, which are now in the hands of the Governor. These bills limit water appropriations for the use in generating electricity for power and other purposes, to a period of twenty-five years, renewable upon application. While this law will not affect existing water rights, it obstructs the future development of water power and menaces the principles of conservation which the measure is supposed to serve.

Water locations are usually made by men who can spend enough money to build roads, make the preliminary surveys and commence canal construction, but who can seldom finance the building of a modern power plant, necessarily interesting outside capital.

This measure would deter capital from investing in water power projects even more than has the former uncertain tenure of Forest Reserve lands, as it governs all water rights whether located in Forest Reserves or not.

Further than this, the period is of shorter duration than that required to mature bonds which would be considered safe and acceptable.

The tendency of these bills will be then to discourage the development of water power by the people and provide a practical immunity from interference or competition for the existing power companies, and with this immunity will tend to throw undeveloped water appropriations into the hands of these same companies where they desire further extensions for their own uses. This is entirely at variance with the present national policy of conservation.

Promoters' Responsibility

The following paragraph reflecting upon the credit and good name of one of California's greatest and most modern hydroelectric enterprises, which is at once unfair both to the company and the bond house handling the securities, appeared in a New York financial paper last week:

"Since the failure of the negotiations to merge the Great Western Power Company and the Pacific Gas & Electric Company, the 5 per cent bonds of the Great Western Power Company have been dull and inactive around 85. A year or more ago they sold ten points higher. Among bankers it has been known that a certain house which had been a large operator in western railroad and power bonds took over, at the time the indications were very strong that the merger plans would succeed, a block of $1,500,000 of these bonds, anticipating a lively and more attractive market for them because of the improved position due to the many economies the merger would permit to be made. Now that the merger scheme is off, there is some curiosity expressed as to where the house is to find a market for these securities."

During construction the bonds were at par, proving at least public confidence in the project. Even after regular operation was commenced, when the earnings were necessarily small, bond prices were high. They gradually decreased in value until the announcement of the proposed merger, which was in effect a long time lease in which the lessor guaranteed the bond interest. The failure of this deal was sure to have a certain depressing influence not caused by any lack of value in the company's physical security. Even the recent acquisition of the property of the City Electric Company in San Francisco has not sufficed to neutralize this depression.

There can be no question as to the value of the properties which stand behind these bonds; the plant and equipment are thoroughly modern, embracing the best class of engineering and construction, the future possibilities of development on the company's other water rights are large and a better physical security of this nature is seldom found. Yet the bonds are not in popular demand at present. It is evident that the public apathy is due to some deeper cause.

The real reason rests in the manner of promotion and its consequent effect upon the public mind. Promotion stock, tendered as a bonus with bonds purchased at an early date, has been sold, thus making the actual cost of the bond to the purchaser very low. These bonds, in some cases, have been offered below prevailing rates and have effected the market to some extent. But the public's bias is due to statements, invariably overdrawn and misleading, causing them to expect results far beyond the scope of the project and which have eventually caused a popular doubt as to the sincerity of the promoters and real value of the property. Furthermore, this idea has been driven home by the continued depression following the wholesale dumping of promoters' stock on a market too weak to quickly absorb it.

The careful investor scrutinizes the moral risk of a proposition even more thoroughly than its physical value. The manner in which their money is to be handled is more vital than the mere chattel it may buy. Several bonding houses, through years of fair and honest dealings, have established a public confidence which ranks their stamp of approval with that of the Federal government. They do not indorse the visionary prospectus of a promoter. Paper profits are theoretical and must be made real before dividends can be declared. This is the work of an able management, made up of conservative and well-balanced engineers and business men, known to the world in a broader sense than through cunning schemes of promotion or petty politics. Time is here the essence of the matter.

PERSONALS.

A. M. Hunt has returned to his San Francisco office after making a Northern California trip.

D. S. Kramer, sales engineer with the Century Electric Company of St. Louis, Mo., is at San Francisco.

C. L. Cory, has returned to his office at San Francisco after a trip to Los Angeles on electrical engineering business.

Leon Bly, secretary of the Tehama Light & Power Company, of Red Bluff, was a San Francisco visitor during the past week.

M. F. Skeel, salesman for the Benjamin Electric Mfg. Co., is making a trip through Oregon, Washington and British Columbia.

S. Wyman Rolph is now connected with the sales department of the Aylsworth Agencies, at 143 Second street, San Francisco.

Wynn Meredith, manager of Sanderson & Porter's Pacific Coast branch office, visited Eureka last week, accompanied by H. W. Crozier.

Frank H. Short, of Fresno, who is interested in electric power enterprises in Southern California, spent a few days at San Francisco during the past week.

J. W. White, of the San Francisco branch of the Fort Wayne Electric Works, has returned to San Francisco after a trip through the interior of California.

Geo. L. Hoxie of New York has been retained by the Board of Public Utilities of Los Angeles to act on a board of engineers to advise on rates for electric light and power.

Carl D. Heise, of the sales department of the Westinghouse Electric & Manufacturing Company's San Francisco office, recently returned from a vacation trip to Honolulu, accompanied by Mrs. Heise.

F. H. Poss, manager of the Pacific Coast Department of the Holophane Company, also Pacific Coast Sales Agent of the Benjamin Electric Mfg. Co., is on a short trip through the southern part of California.

F. W. Hild, formerly chief engineer and assistant general manager of the Havana Electric Railway Company, has been appointed general manager of the Portland Railway, Light & Power Company at Portland, Ore.

H. H. Noble, president of the Noble Electric Steel Company, returned last Monday from Heroult, where he spent several days in connection with the blowing in of the electric furnace at the company's iron smelting plant.

F. E. Cronise, manager of the new business department of the Pacific Gas & Electric Company, has returned to his San Francisco office after spending a month in eastern cities acquiring information for the benefit of the service.

H. B. Therber, of the engineering staff of Sanderson & Porter, who has been in Arizona and New Mexico for some time, arrived last Tuesday at San Francisco, where he will spend a week, before returning to the New York office.

A. S. Kalenborn has resigned from the engineering staff of Stone & Webster at Reno, Nevada, and will start a motor-renting business at San Francisco in conjunction with A. J. Paul, formerly with the City Electric Company of San Francisco.

S. T. Wellman, of the Wellman-Seaver-Morgan Company, manufacturing engineers of Cleveland, who is acting as consulting engineer for the Noble Electric Steel Company, went to Heroult last week. He was present at the successful resumption of iron ore smelting at the plant, and will remain there for some time in connection with the installation of three improved electric furnaces.

C. H. Weldon of San Francisco has been promoted to the position of division auditor of the Pacific Telephone & Telegraph Company's Northern Division, with headquarters at Portland, Ore. He will have charge of revenue and general accounts.

TRADE NOTES.

The General Electric Company has sold to the San Jose Railroads, of San Jose, Cal., 12 two-motor car equipments, with G. E. 216 motors, and the K 36 controllers for same.

The San Joaquin Light & Power Corporation has purchased from the General Electric Company a Curtis turbine exciter set rated as follows: C. C-4-75-kw.-3300 r.p.m.- 125/125 v.-direct current.

Otis & Squires, 155 New Montgomery street, San Francisco, have been appointed agents for the American Transformer Company of Newark, N. J., and will carry a complete Pacific Coast stock.

The Caldwell Machinery Company of Seattle has succeeded to the business carried on for the past sixteen years under the firm name of the Caldwell Brothers Co. The officers of the new company are: George H. Tinker, president and general manager; Robert C. Polk, secretary; Alexander Hamilton, treasurer. In addition to the foregoing Louis Walter and George F. Kuentzel form the directorate.

J. W. Swaren has opened offices as a consultant on technical advertising in the Shawmut Building, San Francisco. Mr. Swaren was formerly complaint engineer with the General Electric Company at Chicago, later taking charge of the experimental laboratory of the Pacific Gas & Electric Company at San Francisco for three years and a half. He has made a special study of developing new business methods for central stations and has been advertising manager for a number of San Francisco machinery manufacturers.

REANIMATION OF SAN FRANCISCO JOVIANS.

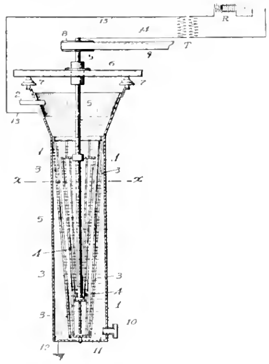
Soon after the Ides of March an energetic bunch of live wires at San Francisco formed a cable (a Jovian cabal) of sufficient carrying capacity to electrify and revivify those Rejuvenated Sons of Jove who are not dead, but sleeping. Mythology tells us that immortality was granted to but few descendants of the almighty Jupiter and that all others must be rejuvenated. Those of San Francisco are also to be regenerated by a dy-no-mo(re) machine which will give eternal life to the local organization.

The I. W. W. (Industrious Willing Workers), otherwise known as the welfare committee, consisting of Statesman W. W. Briggs (ex-officio), C. C. Hillis (National Vulcan), H. E. Sanderson, F. B. Gleason, F. H. Poss, S. H. Taylor, S. B. Gregory are to recommend the formation of a local Jovian Club to foster the true spirit of Jovianism. Nominal quarterly dues are to be put into effect. Jupiter A. E. Drendell guarantees a drill team that will deliver the ritual letter-perfect in an impressive manner and every preparation is being made to pull off a record-breaking rejuvenation in the near futnre. Other plans include an electrical picnic and a dinner-dance, both of which functions the Jovian wives can attend. Last, but not least, it is planned to start an energetic campaign to bring the national meeting to San Francisco in 1915, when the Panama-Pacific Exposition will set apart a day for Jovianism.

The March 21st meeting of the Portland Section, A. I. E. E. was somewhat of a New Business Session, A. C. McMicken presenting a paper on "Methods of Obtaining Business for the Central Station," and A. S. Moody speaking on "Methods of Selling Electric Appliances." Supplemental talks were given by C. L. Wernicke and L. Quimby.

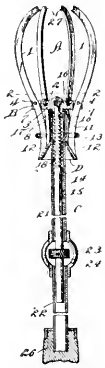
PATENTS

987,117. Separating and Collecting Particles of One Liquid Suspended in Another Liquid. Frederick Gardner Cottrell and Allen Cheever Wright, Berkeley, California, assignors, by mesne assignments, to Petroleum Rectifying Company, San Francisco, Cal. The improvement in the art of separating and collecting particles of one liquid suspended in another liquid which latter is essentially a non-conductor of electricity, consisting in passing the material



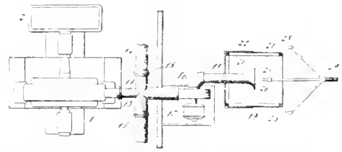
to be treated through the field of electrodes connected to a source of electricity of sufficient voltage to produce coalescence of the suspended particles in such wise as to cause the separation of the two liquids throughout the body of the mixture; and rotating at least one of the electrodes whereby said mixture during and throughout its course through the electric field is agitated with the effect of preventing the coalescing globules from forming complete chains short circuiting the electrodes.

987,562. Electric-Lamp Changer. Mark Ferguson, Pasadena, Cal. A device of the class described comprising a head, a tubular handle rod connected therewith and provided with longitudinal slots, a wedge movable on the rod and having a portion extending through the slot and disposed within the



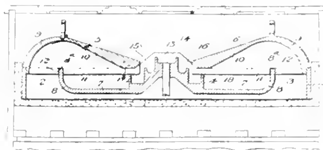
handle rod, a screw rotatably mounted in the handle rod and engaged with the wedge for shifting the same, a connection between the head and screw for preventing the screw from moving longitudinally, jaws mounted on the head and having portions engaged with the wedge, and yielding means coacting with the wedge to move the jaws.

987,536. Method of and Apparatus for Cooling Electrical Generators and Motors. Frank George Baum, San Francisco, Cal. A method of cooling electric generators which consists in directing a current of air in a predetermined direction, saturating such current of air with moisture, injecting a predetermined amount of water in the form of particles into



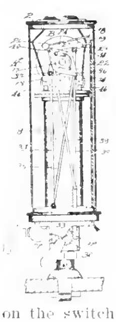
said air current whereby such water may be entrained therein, supplying said air under pressure to a conduit disposed adjacent to and heated by the parts to be cooled, completely evaporating the said entrained particles of water before said particles emerge from said conduit by the heat of the parts to be cooled and thereafter conducting the air so freed from entrained moisture past the said parts.

987,617. Black-Oil Burner. James Warren Elder, Visalia, Cal. In a duplex oil burner, the combination of a tray, vaporizing pans carried thereby, an oil-distributer composed of troughs disposed in stepped arrangement adapted to direct



the flow toward both of the pans, said tray having air inlets, and movable deflectors disposed over the respective air inlets and over the respective pans which direct all of the air from the inlets to the pans and distributer and prevent it from taking any other course

987,493. Electric Water-Heater. Herbert N. Roche and William Ruth Ray, San Francisco, Cal., assignors to Thomas B. Gray, San Francisco, Cal. The combination in an electric water heater, of a rotary electric switch and its stem, a water controlling valve, and means connecting said valve and said switch, said means including a pair of oppositely oscillating



plates loosely mounted on the switch stem, pawls carried by the plates and engageable with the ratchets fast on the stem when the plates move the pawls in the same direction, and pairs of links connecting the plates and the valve, whereby the switch may be actuated, one pair of said links effective to push on opposite ends of the plates and the other pair effective to pull on opposite ends of the links simultaneously.

INDUSTRIAL

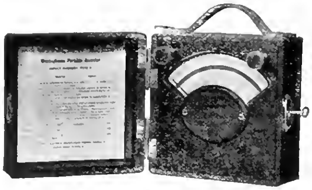
DIRECT CURRENT PORTABLE METERS.

For commercial testing of direct-current apparatus under all conditions, the Westinghouse Electric & Manufacturing Company, of Pittsburg, have recently placed on the market a new line of portable meters and shunts, known as the type R. In the design of these meters the aim was to produce an instrument of high accuracy at a reasonable cost.

With all indicating meters two kinds of errors affect the accuracy of readings. The first kind are due to errors in reading caused by traces of friction, parallax, coarseness of dial markings and similar factors; these errors are independent of the load. The second kind are due to inaccuracies of the meter itself, inaccuracies in calibration, errors in standards used and causes that vary the constants of the instruments. The possible error in reading due to errors of the first kind will be a fixed percentage a of the full scale, and due to errors of the second kind a fixed percentage b of the actual reading. The probable accuracy at any point of the scale will then be expressed in the form

$$\text{Percent possible error} = \frac{aC - bc}{c}$$

in which $C =$ full scale, and $c =$ actual reading.



Type R Portable Meters.

The Type R meters are standardized by direct comparison with absolute standards, and therefore have high initial accuracy, while in their construction every endeavor is made to make the accuracy permanent. The factor b in the above formula is guaranteed not to exceed 0.2 per cent. The factor a depends on personal skill in reading. The clearness of the scale divisions and the mirror running the entire length of the scale to prevent parallax make it safe to assume 0.1 per cent for the factor a with type R meters.

The general appearance of the meters is shown in the accompanying illustration. They operate on the D'Arsonval principle, a moving coil and permanent magnet, which insures freedom from residual error. They differ from most meters operating on this principle in having only a single air gap in which the moving coil, pivoted at one side, swings. This construction permits the entire moving element to be removed and replaced without disturbing the magnetic circuit and allows the entire magnetic circuit to be magnetized, "aged" and tested as a unit, insuring permanence of its strength.

The moving coil is of silk covered wire wound on a light metal frame. This frame acts as an effective damper, resulting in inherently dead-beat readings. The control spring is so supported that its weight is supported by the stationary frame and not by the moving element. This makes the moving part lighter and increases the life of the jewel pivot bearings.

The scales of the meters are 6 inches in length, and hand calibrated to correct for any slight inequalities in the magnet faces. Each scale is provided with a mirror running its entire length, to prevent parallax.

Each meter is mounted in a black walnut carrying case with flexible leather handle. The cover is attached with butt hinges, so that it can be quickly removed when in the way and easily replaced. All metal parts, mounted on a black insulating face plate, are finished in bright nickel.

Instruments of this type are furnished as ammeters, voltmeters, millivolt-meters and volt-ameters. The millivolt-meters are intended for use in connection with portable interchangeable shunts for the measurement of large currents or where a single meter is to be used for a large range of measurements. Interchangeable portable shunts are furnished in capacities of 5 to 1000 amperes and for either 50 or 100 millivolts drop at full load. Each shunt is mounted in a polished walnut box, or a combination box is finished to accommodate several shunts.

The shunts included in the Type R ammeters and the portable shunts for use with the millivolt-meters are made of manganin, a special resistor material having negligible temperature coefficient and thermo-electromotive force. The terminals of the portable shunts are generously proportioned.

WESTERN ELECTRIC BLACK ENAMEL WIRE.

Before the Western Electric Company offered its black enameled wire to the open market it gave its product a four year's trial in the manufacture of its own apparatus. Black enameled wire is now used extensively in the magnetic coils of Western Electric telephone apparatus and is being used with great success as well by many other large manufacturers of electrical apparatus.

The demands of the larger manufacturers of electrical apparatus, particularly apparatus of the types in which small magnetic coils are used, for an insulated wire which would enable them to increase the efficiency of their product while decreasing its cost, have led to the development of a black enameled insulation for magnet wire. Efforts in this direction have been rewarded with even greater success than had been hoped for.

Prior to the development of black enameled magnet wire attempts had been made to produce a satisfactory substitute for silk insulation. These were not successful, as the product either did not possess many of the essential features of satisfactory insulation, or it was not such that it could be manufactured commercially. Black enameled wire is now offered to the market by the Western Electric Company and has been tested under the severest conditions. This wire is no longer an experiment or a theory, but a commercial success.

It is claimed for this wire that while the black enameled insulation is only .0002 inches to .0004 inches in thickness, it is so elastic that when the wire is stretched to the breaking point, the enameled insulation does not break until the wire itself gives way. It will withstand the ordinary atmospheric corrosives and the severe atmospheric conditions of shops, factories, tropical climates and the seacoast indefinitely. It is not injured by indefinite exposure to temperatures of 250 degrees Fahrenheit, a temperature which will destroy the tensile strength of cotton or silk in a few hours. It cannot be removed from the wire by the ordinary solvents, and the wire can be handled as easily and successfully as a silk insulated wire.

One of the great advantages possessed by black enameled wire is its small diameter as compared with that of single silk or cotton insulated wire. The winding space (for a specified number of turns) saved by black enameled wire over single silk No. 34 B. & S. wire is 25 per cent.

D.C. MOTOR STARTING PANELS FOR HEAVY SERVICE.

An increasing demand has arisen, especially in the steel and cement industries, for electrical apparatus of rugged construction and liberal proportions, owing to the fact that apparatus as ordinarily designed does not always stand up under the heavy service imposed. There is also a demand for safety attachments for controlling apparatus to prevent unskilled operators from endangering life or apparatus.

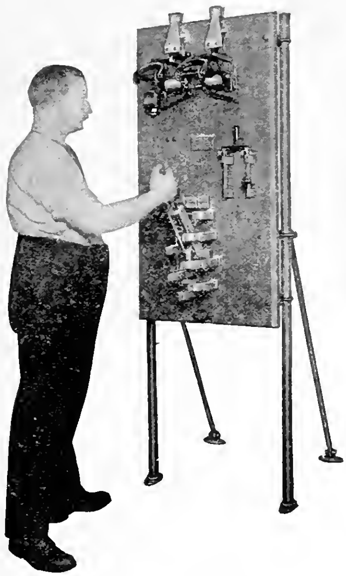


Fig. 1. D.C. Motor Starting Panel for Heavy Service (front view).

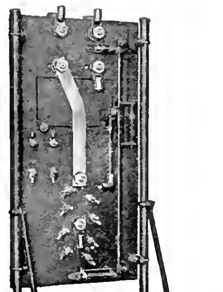


Fig. 2. D.C. Motor Starting Panel for Heavy Service (back view).

The General Electric Company has recently designed and built a number of d.c. motor control panels which meet the requirements of heavy service and safety in every way. The accompanying cuts illustrate clearly the rugged character of these panels. The equipment consists of a slate panel mounted on 1¼ in. pipe supports and braced to the floor or wall by means of pipe braces. The panel carries 1 double pole carbon break circuit breaker, 1 single pole 4 or 9 throw starting switch, and 1 double pole field switch (optional but not recommended by the General Electric Company). Necessary interlocks, connections and small resistances.

The starting resistances are usually set on the floor and connected to the switch by means of leads. When the equipment is for a small motor, suitable arrangements can be made for mounting the starting resistance on the panel pipe supports. In the design of starting switch used the results of years of experience has been incorporated, and it is difficult to see where any material improvement could be made. It is impossible, with this switch, to operate otherwise than step by step. A pawl on the handle lever engages in teeth on a ratchet wheel rigidly attached to the contact blade. As the handle is operated back and forth with a sort of pump handle motion, the ratchet wheel is turned and thus the blade is moved from one contact to another.

The circuit breaker and starting switch are interlocked in such a manner that the circuit breaker cannot be closed until the starting switch is in the "off" position. Also if, after the circuit breaker is closed and the starting switch is in an intermediate position, the operator removes his hand from the starting switch handle the circuit breaker will immediately open. Where a field switch is supplied it is also interlocked with the circuit breaker so that the latter cannot be closed unless the field switch is closed. The opening of the field switch causes the circuit breaker to trip.

All the parts are strong and will stand considerable rough usage.

NEW CATALOGUES.

The Sprague Electric Company in Bulletin No. 111 gives a partial list of installations of their engine type generators, illustrating a number of noteworthy plants.

The Century Electric Company, in Bulletin No. 15 have issued an attractive catalogue of Century Alternating Current Fan Motors, employing the split phase induction principle.

Circular No. 1190, just issued by the Westinghouse Electric & Manufacturing Company, describes type "E" engine driven alternating current generators from 50 to 1100 k.v.a. for operating on 60 cycle, 240-2400 volt circuits.

Bulletin No. 1042 from the Allis-Chalmers Company describes their generators and A B C engines. This covers the small direct connected units which find service in lighting plants as exciters and in office buildings, etc., for light and power.

The discussion of induction motor design presented in Bulletin 126 recently issued by the Crocker-Wheeler Company of Ampere, N. J., is handsomely illustrated throughout with half-tone engravings which show many interesting applications as well as presenting the details of construction of the machines.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has recently issued several new catalogue sections including the following: No. 228, Enclosed Fuse Blocks; No. 229, Subway Fuse Boxes; No. 553, Automatic Voltage Regulators; No. 731, Instrument Transformers; and No. 735, type S and SA Distributing Transformers.

Recent additions to the Westinghouse Electric & Manufacturing Company's Perpetual Catalogue No. 3001 include: Section 317, Type D Indicating Meters for Direct Current; Section 319, Types H, HA and HB Edgewise Switchboard Meters for Direct Current, Section 333, Electrostatic Voltmeter for Voltages up to 200,000 volts; and Section 578, Type A Overvoltage Relays for Direct Current Circuits.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has been incorporated by P. S. Scales, J. H. Sandford, Rudolph Spreckels, Frank Harrold and Claus Spreckels, with a capital stock of $1,000,000.

TRANSMISSION.

SUMAS, WASH.—The Western Canada Power Company will establish a $100,000 power plant and substation here, construction work to begin this year.

OLYMPIA, WASH.—J. W. Bullard, architect, of Tacoma, will have charge of the construction of the $35,000 power house and the $65,000 hospital building at the Veterans' Home in this city.

WALLA WALLA, WASH.—A new 1250 k.v.a. generator for the Pacific Power & Light Company is being installed at the Walla Walla river plant. The company has just completed a new substation here.

RENO, NEV.—When the new power plant of the Truckee River General Electric Company is completed that plant will be able to develop 4000 h.p. and will be the largest plant owned by the company on the Truckee River. When completed the plant will cost about $500,000.

PROSPECT, ORE.—Contracts to the extent of $890,000 have been let for the construction of the new power plant of the Rogue River Electrical Company at Prospect, on the Rogue River. The machinery contract includes a power wheel and three generators, capable of generating 80,000 horsepower.

SACRAMENTO, CAL.—Hereafter corporations may acquire water-power privileges for but 25 years, if two bills passed by the Senate receive the Governor's signature. When the 25 years have run the corporation using the water, for developing electricity or other power may renew the lease, and the title to the water will always remain in the State.

WHITE SALMON, WASH.—All the property of the Husum Power Company has been purchased by the Pacific Power & Light Company of Portland, and will be operated as part of its system hereafter. The plant consists of a water-power station at Husum on the White Salmon River, about eight miles of transmission line, and distributing systems in Husum, White Salmon and Bingen.

PORTERVILLE, CAL.—C. H. Holley, manager of the Tulare County Power Company, is making contracts with the farmers to supply electricity to them. Mr. Holley states that as soon as the required number of contracts have been signed up to use the surplus power, he is to get the deeds for the rights of way for the line to connect this city with Visalia, Exeter, Lindsay, Strathmore and Tulare.

KENNEWICK, WASH.—The new 66,000 volt line between Kennewick and Walla Walla, a distance of 50 miles, has been put into operation by the Pacific Power & Light Company, thus making a continuous line 210 miles long from Naches, Washington, to Pendleton, Oregon. From Kennewick, workmen are now building a 66,000 volt line northward into Central Washington, and already have about 80 miles of line completed. They will build about 50 miles further, and the new line will connect the Priest Rapids power plant with the other plants of the Pacific Company. A line is being built west from Priest Rapids about 30 miles to North Yakima, thus making two separate lines between Naches and Kennewick.

HUSUM, WASH.—The Northwest Electric Power Company, with headquarters at Portland, has completed two water-power surveys and water-power rights filed, along the White Salmon River. A dam 50 ft. in height is to be erected and water conveyed for power and irrigation purposes for a distance of three miles along the west side of the river, where a power plant will be installed. Charles M. Huff filed the water rights.

PHOENIX, ARIZ.—The Water Users' Association has awarded contracts for all machinery for the south side power house of the South and Consolidated canals east of Mesa, to the following contractors: The S. Morgan Smith Company of York, Penn., for hydraulic turbines at $16,590, which includes 48 turbine wheels and all the governors, pumps and auxiliary that goes with them; General Electric Company, contract for the electric part of the plant which includes two generators and corresponding transformers and switchboard apparatus at $30,000. About four months will be taken to complete and deliver machinery, meantime the building will be made ready and a necessary short piece of connecting canal completed.

QUINCY, CAL.—A power company has been formed to develop the hydroelectric resources of the middle fork of the Feather River. A corporation, to be financed by New York capitalists, is now being formed, it being planned to build a series of power houses with a total capacity of 85,000 h.p. It is also planned to build storage reservoirs and canals. Among the promoters are George H. Tully, M. P. Barnes and H. R. Lind, the latter being a Nevada mining man. Transmission lines will be extended in all directions in the valley, in order to compete with the Great Western Power Company and the Pacific Gas & Electric Company in supplying electricity to the towns in the valley and furnishing power for irrigation pumps and other purposes.

OGDEN, UTAH.—Within the next 60 days, the time required for the preparation and delivery of the $500,000 worth of bonds which have been sold by the Davis & Weber Counties' Canal Company, active construction work will be started on the power plant which is to produce 5454 h.p. The doubling of the capacity of the reservoir on East Canyon Creek, which will require the enlarging of the present dam, will also be completed during the present year, but the work will not be started until the construction of the power house is under way. The power house, which will be built near Riverdale and about eight miles from the head gate of the canal, will cost in the neighborhood of $300,000. The building of this power house is made possible through the issue of the $500,000 worth of bonds, which were sold to Denver capitalists and to the Commercial National Bank of this city.

PORTLAND, ORE.—It was announced by Guy W. Talbot, president of the Pacific Power & Light Company, that a new 66,000 volt line will be built between the company's plants at Hood River and The Dalles, Oregon, a distance of 22 miles. This work is already under way, and estimates are being prepared for an additional 130 miles of line which will extend from The Dalles eastward along the Columbia River to Kennewick, and there connecting with the company's main line between Naches and Pendleton. These lines, in addition to furnishing reserve power, are for the purpose of distributing current to the many irrigating plants along the

Columbia River. Mr. Talbot also announced that just as soon as possible a 3000 kw. plant would be built on Hood River, and the White Salmon River plant at Husum will be greatly enlarged. A submarine cable will be laid to connect the White Salmon plant with the Hood River plant, and the two will be connected to The Dalles by the new line. The company is just finishing installing 1800 h.p. of new water wheels at the White River plant which furnishes The Dalles, and a complete new 1250 k.v.a. generating unit is on order, which is expected in June. The White River plant is connected to The Dalles by 30 miles of 22,500 volt line, and just as soon as the new line is completed to Hood River so the load can be taken care of from that plant, the line between The Dalles and White River will be rebuilt to 66,000 volt capacity.

ILLUMINATION.

LOS ANGELES, CAL.—Eleven miles of gas pipe has arrived from the East and will be installed at Beverly Hills.

WILLOWS, CAL.—Van E. Britton of San Francisco, engineer of the Northern California Power Company, was here last week making the survey for Willows' new gas plant.

LOS ANGELES, CAL.—The City Council has passed an ordinance to order the necessary appliances to be installed and electric current to be furnished for one year for lighting Third street from Main to Hill street.

SPRINGFIELD, ORE.—The Springfield Council has granted to the Oregon Power Company a gas franchise in Springfield. A four-inch main, four miles long, will run from the Eugene gas plant. A reducing plant will be established here.

SUSANVILLE, CAL.—The Lassen Electric Company has made application to the Board of Trustees for a franchise, for a period of 50 years, to erect, construct and maintain poles and wires for the transmitting of electricity for heat, power, and light in the town of Susanville.

SACRAMENTO, CAL.—Assembly Bill No. 466, introduced by Assemblyman Schnitt of San Francisco, was passed by the Senate and goes to the Governor. It amends Section 629 of the Civil Code, which now requires corporations to furnish gas and electricity on demand, so as to include steam and heat, which must be supplied to householders residing not more than 100 feet from the mains on application and payment.

EUGENE, ORE.—The formal beginning of operations at the Eugene municipal electric plant at Walterville, on the McKenzie River, took place last week, and the members of the City Cuncil, and a large number of citizens inspected the plant. The plant has been built at a cost of $300,000 and has been in course of erection for two years or more. It will supply power for the operation of the pumps at the municipal water plant and will furnish light for the streets. Later the Council plans to do a commercial business.

ANAHEIM, CAL.—Mr. C. S. S. Forney of Los Angeles, has filed a petition with the Board of Supervisors asking them to advertise for sale a franchise for gas mains on roads, streets and alleys in large portions of the county. It has been rumored that the Los Angeles Gas & Construction Company expects to build a central plant to supply Orange, Anaheim and Fullerton, also that the Los Angeles Light & Power Company intends to supply Orange County towns from Los Angeles.

BAKERSFIELD, CAL.—A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, following a conference held in this city with W. C. Balch of Los Angeles, vice-president of the corporation, and A. E. Wishon of this city, manager of the southern division, announces plans of the company to add at a cost of $250,000, 6667 horsepower to the present capacity of the new steam generating plant recently completed in this city, which will make the local plant the largest steam generating electric plant in the valley. Orders have already been placed for the boilers and tube generator, which is to be a duplicate of the one now in use. When installed, the new generator will give the plant 11,600 horsepower. The improvements, to cost $250,000, will make the company's investment in the new steam plant $450,000.

PORTLAND, ORE.—Formal announcement is made by President Josselyn, of the Portland Railway, Light & Power Company, that in the next two years the company will expend $4,000,000 in the development of electrical energy plants, so as to place the company by 1914 in a position to furnish electrical power in a large district in Oregon and Washington. With construction work now under way, coupled with the work laid out for 1911 and 1912, the company will be able to produce 100,000 horsepower by water generation. This amount includes the 15,000 horsepower plant at Oregon City, the 25,000 plant at Cazadero, 25,000 horsepower at Estacada, which will be completed in September this year, and 40,000 additional horsepower on the Upper Clackamas. With the project on the Upper Clackamas, which will be finished in 1914, the company will be able to utilize the fall of the water in this one stream at three different locations. With all these plants completed and with the necessary high tension wire built the company will have expended $7,000,000, the construction already completed representing an outlay of $3,000,000.

BAKERSFIELD, CAL.—A. E. Wishon, assistant manager of the San Joaquin Light & Power Corporation announces a reduction in electric and gas rates for Bakersfield to be effective April 1. The new rates will be of greatest advantage to quantity consumers, but all users will be benefited by the new schedule. The present electric rates are on the basis of 20c per kilowatt hour with a discount allowed on the amount of the bill, while the new rates are to be based upon the hours which the installed capacity of electrical equipment is used, and are graduated in this classification from 12c per kilowatt hour down to 4c per kilowatt hour. To the smallest consumer on the line this will mean a reduction of 1c per kilowatt hour over the existing rate, but the reduction to larger consumers will be much more. The rate on commercial motors, which at present is from 8c down to 2c per kw. hour, will be reduced to 6c down to 1½c per kw. hour. The gas rate now effective is as follows: First 5000 cubic feet, $1 per 1000; next 10,000 cubic feet, 75c per 1000; all over 10,000 cubic feet, 50c per 1000. The 50c rate is the new one. A special rate of 50c per 1000 cubic feet is also offered for heating purposes, providing a separate meter is installed to measure gas used solely for this purpose.

TRANSPORTATION.

MODESTO, CAL.—The Tidewater & Southern Railway has succeeded to a large degree in overcoming objections to its proposed route over Ninth street in this city, to the extent of getting the ordinance granting the permit introduced by the Board.

MODESTO, CAL.—The Board of Trustees has passed an ordinance granting to the San Joaquin Valley Electric Railway a 25-year franchise for a single or double track, standard gauge street railroad tracks, to be constructed between the city of Stockton and the city of Modesto.

NAPA, CAL.—Theo. A. Bell, attorney for the Napa & Lakeport Railroad, has asked that the franchise for the road for operating on Union and other streets of this city be extended for one year. He said that W. Rankin is now in the East completing the financing of the new line.

EASTON, CAL.—Ansel Easton has applied to the Burlingame Trustees for a franchise for a street railway in this city.

SEATTLE, WASH.—The Seattle-Electric Railway Company has been granted a permit to erect car barns at 1005 East Madison street, this city.

SACRAMENTO, CAL.—The franchise applied for by the Sacramento Electric, Gas & Railway Company to run a cross-town line from Fifteenth and I streets to the Western Pacific depot at Nineteenth and K, and on to Twenty-first and P streets, has been referred to the judiciary committee, after being vetoed by Mayor Beard for the reason that it lacked proper restrictions and safeguards to the city.

OAKLAND, CAL.—The Oakland Traction Company has been granted a franchise on Hopkins street from Fruitvale avenue to Redwood road. The bid is $1000, the company agreeing to maintain lights along the line. The same company withdrew an application for a franchise in East Sixteenth street, and the Scenic boulevard, filing a new one, which substitutes Ignacio avenue for the boulevard.

SAN FRANCISCO, CAL.—The Northern Electric Company, with offices in the Alaska Commercial Building, has the preliminary plans out for extensive improvements which are to be made to the system of Marysville. The company has acquired valuable property in that city which will be improved by the construction of a modern passenger depot, freight sheds and additional trackage. The work will probably not be undertaken until late in the year.

RED BLUFF, CAL.—An electric railway to connect Willows, Woodland, Colusa, Orland, Corning, Red Bluff and Redding is proposed as a result of a meeting held here last week between Charles L. Donohue, an attorney of Willows; a civil engineer from Los Angeles, and local capitalists. A meeting of capitalists interested will be held at Willows and the company organized. Attorney Donohue submitted estimates of cost at the meeting here Sunday to show that the line can be built and equipped for $2,200,000.

LOS ANGELES, CAL.—Following the consolidation of the Pacific Electric, Los Angeles Pacific and Los Angeles and Redondo electric lines under the ownership and management of the Southern Pacific and as a result of the recent visit to this city of Judge R. S. Lovett, president of the Southern Pacific, there has been sent to him in New York a complete report as to needed improvements for the electric lines. These include the widening of the gauge of the Los Angeles and Redondo and of the narrow-gauge line between Los Angeles and San Pedro and the completion of the equipment of the Sentous line. From Clement Junction cars will be run over an S. P. track to the Arcade station, where passengers and baggage for beach points will be received from S. P. trains, elminating the present necessity of transporting them across the city to the depots of the electric lines.

WATERWORKS.

SILVERTON, ORE.—The Marshon Construction Company of Seattle has been awarded the contract for the construction of the water and sewer system for Silverton, Ore. The bid is $63,940.

OAKLAND, CAL.—The Bay Cities Water Company is serving water in the San Leandro district, having completed that section of its construction work, and is now rushing the construction of the second section of its system, the laying of pipe in the Elmhurst and Fitchburg district. As soon as carloads of pipe, now delayed in transit on account of storms, arrive from the East, the task of building the Alameda system will commence.

WILSON CREEK, WASH.—The Northwestern Improvement Company, a corporation, has petitioned the county commissioners of Grant County, Wash., for a franchise giving them the right to operate water pipes for conducting water in the city.

WENATCHEE, WASH.—Plans are now under consideration by Mayor A. C. Dallach and members of the municipal council to improve and to increase the city's water supply. They contemplate the purchase of a new pump to cost about $5000 and to be installed in the station on the bank of the Columbia River at the foot of Fifth Street North.

BELLINGHAM, WASH.—City Engineer H. A. Whitney has been instructed by the water board to make surveys and prepare estimates on the cost of extending the Larsen pumping system by running an 8-in. main or 6-in. main or the two sizes in alternation, down Electric avenue, Spruce street and the Geneva road from the city intake to a point near Forest Landing.

SAN FRANCISCO, CAL.—The city has closed its option on the Cherry Creek section of the Hetch-Hetchy and Lake Eleanor water system for $600,000. The Supervisors unanimously instructed the public utilities committee to execute a contract of sale. The money to pay Ham Hall and his associates will be taken from the proceeds of the $1,250,000 bond sale on April 20. With the balance City Engineer Manson will begin construction of the dam at Lake Eleanor, doing the work of stripping down to the foundation this season, constructing a wagon road to the site and digging canals to unite the Cherry Creek watershed with Lake Eleanor.

OAKLAND, CAL.—Under a decision of the U. S. Circuit Court of Appeals at Seattle, in what is considered an analogous case, it is the opinion of the city attorney and special attorneys engaged in the water-rate cases, that Oakland will soon be relieved of the burden of its water-rate injunction suits pending for years, and now costing the city fully $40,000 a year to defend. The opinion was presented to the city council and it was announced that in the near future the U. S. Circuit Court would be moved for a dismissal, following the decision in the Seattle case, upon the ground that the United States Courts have no jurisdiction in matters where the State constitution embodies the provision of the United States Constitution, that no one shall be deprived of life, liberty or property without due process of law.

SAN FRANCISCO, CAL.—To bring the city and the Spring Valley Water Company together upon some amicable ground to arrive at some solution of the municipality's water problem during the next five years, Supervisor Murdock has introduced a resolution in the board which sets forth that the city vitally needs more water; that the delays of court procedure made uncertain when the Federal adjudication as to values might be expected; that virtually everybody wanted the city to acquire the Spring Valley plant upon fair terms and that the interests of the city demanded united action. The resolution itself invited the organization referred to to co-operate and the Spring Valley Company to enter into negotiation in a friendly spirit and asked the various city departments to lend their aid in an early general conference. Following are the organizations referred to, each of which is to be requested to authorize its president or a properly accredited delegate "to act in conjunction with the public utilities committee in a determined effort to arrive at a settlement of the matters at issue"; Merchants' Association, Chamber of Commerce, Labor Council, Building Trades Council, Real Estate Association, Press Association, Civic League, Bar Association, California Development Board, Commonwealth Club and board of directors of the Panama-Pacific Exposition.

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ELECTRIC EQUIPMENT OF COLUMBIA STEEL PLANT

BY W. W. HANSCOM.

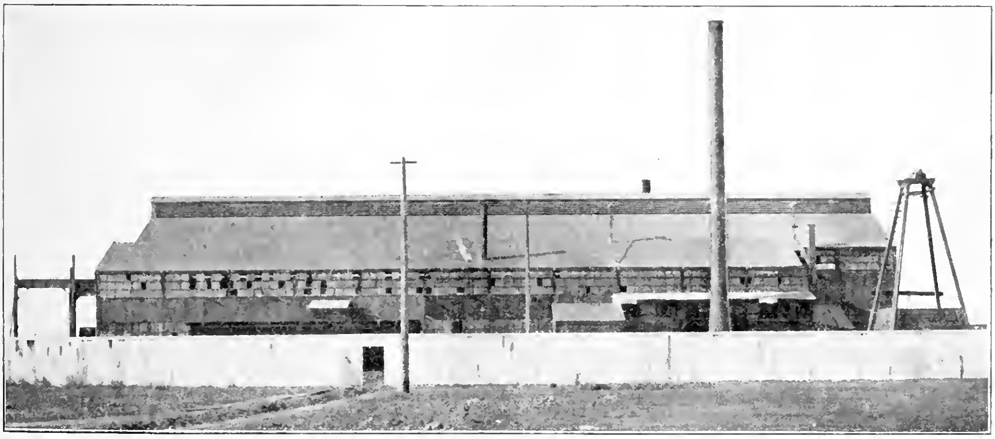
The plant of the Columbia Steel Company, devoted exclusively to the making of steel castings, is situated on the banks of the New York Slough about thirty miles from San Francisco and about one mile from the town of Black Diamond, since renamed Pittsburg.

The location is ideal from a manufacturing standpoint, having direct communication by rail and water with the surrounding territory. The main lines of the Southern Pacific and Santa Fe Railroads connect with the spur tracks running through the works and the river steamers land at the company's private wharf.

The grounds cover an area of twenty acres and have a water frontage of 800 ft. The surface is naturally level and the soil such as to form a good foundation for the storage bins and buildings. Part of the ground area is covered by the foundry, office, chemical laboratory, pattern loft, pattern shop, storage bins, living quarters for the men and oil storage tanks, leaving considerable room for future extensions. The first of the buildings above mentioned is of structural steel, the next four of pressed brick and the balance of wood.

The product covers mild and high carbon steel, manganese and alloyed steel castings.

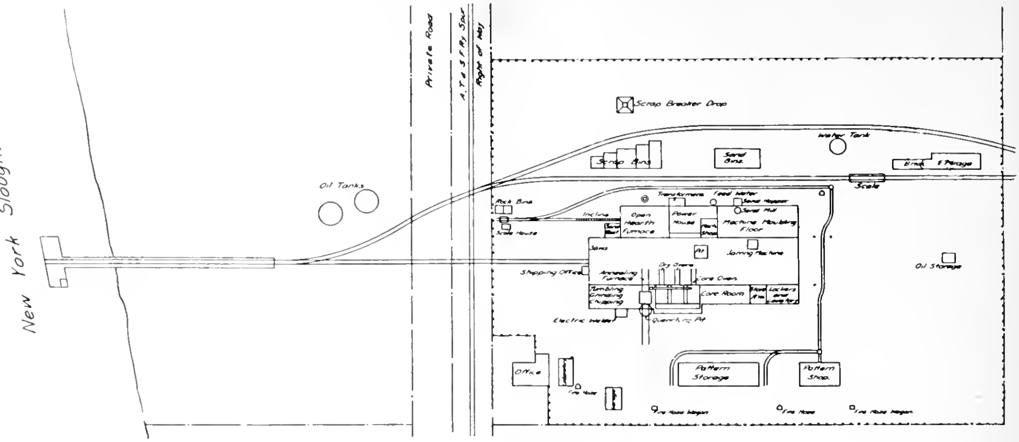
The main foundry building is 260x130 ft. and is of structural steel covered with corrugated iron. The main crane runway is supported upon heavy steel columns resting upon a continuous reinforced concrete foundation. The runway extends to a distance of 40 ft. past the rear of the foundry building and over the flask storage yard.



Plant of the Columbia Steel Company.

Oil is used entirely for fuel and is stored in two large wooden tanks near tide water. From the tanks lead pipes run to the dock for filling and to the works for distribution. The supply is obtained from barges or tank steamers which can tie up to the wharf while discharging. An auxiliary steam boiler is used for supplying steam to the burners and for heating the living quarters when necessary.

The operating portion of the grounds is well cov-



General Layout of Columbia Steel Company's Plant

ered by an industrial track which facilitates the handling of material too light to be transported by the traveling crane or locomotive.

Electricity is used entirely for the operation of the various machines and lighting, current being obtained from the nearby sub-station of the Pacific Gas & Electric Company, through a separate, three-phase feeder, at 4400 volts.

At the property boundary line the feeders pass through a triple pole, pole-top switch, operated from the ground and arranged to entirely disconnect the works in case of necessity.

From the pole the feeders run to a frame structure above the roof and thence through lead covered cable to the switchboard in the power house which is situated about the center of the length and to one side of the main building.

After passing through the current transformers and air break switches, immediately over the main board, the service is connected to the oil primary switches and thence to the transformers.

The air break switches are arranged to entirely disconnect any one of the transformers and its oil switch from the high tension side, for examination and repair.

There are three transformers, made by the General Electric Company, each of 250 k.v.a. capacity, with 4400 volt primary and 440 volt secondary windings. Percentage taps are brought out from the primary winding permitting of connection for a primary voltage ranging from 3950 to 4400. Each transformer has its own control panel upon which is mounted a primary and a secondary automatic release, oil switch, both automatic release coils being connected in series with an inverse time element relay. Connections between the transformers and the board are so arranged as to permit of operating with two transformers connected open delta when the load does not require the use of all three.

The main switchboard consists of five Vermont blue marble panels, three of which are devoted to the control of the transformers, the others having mounted thereon the volt and ammeters, volt-meter receptacle and the distribution switches.

From the switchboard the various circuits lead to the different distribution boards near the groups of motors. The distribution boards are of the panel type mounted in steel cabinets, with vertical busbars, feeding the branch circuits to the motors through enclosed fuses. From the cabinets, the various circuits are lead in conduit underground, to the local switches and controlling devices and from these to the motors.

Wiring System.

Except for horizontal stretches immediately above the roof trusses and on poles, the wiring system is in rigid iron conduit. All of the motors, with the exception of a few small ones, are wound for 440 volts, three-phase. The small motors used on the portable mold dryers and sand riddles are single-phase, 110 volts, and are supplied from the lighting transformers.

Outlets for the portable motors and lights are provided on alternate columns supporting the crane runway and are so distributed as to make it possible to use portable lighting over the entire moulding floor.

Three-phase, 440 volt power outlets are also provided for temporary motors and consist of fused switches mounted in steel cabinets with doors and located conveniently on each side of the main foundry floor.

Motor Operated Machinery.

The following machines are in use at present:

11x12 duplex air compressor with..	75 h.p.,	900 r.p.m. motor
2 lb. centrifugal air compressor....	30 h.p.,	3400 r.p.m. motor
Sand grinder	30 h.p.,	1800 r.p.m. motor
Electric welding motor generator..	50 h.p.,	900 r.p.m. motor
Scrap breaker hoist	20 h.p.,	1200 r.p.m. motor
Tumbling barrel	40 h.p.,	1200 r.p.m. motor
Cut off saw, 26 in. blade..........	10 h.p.,	900 r.p.m. motor
Swing grinder counter	10 h.p.,	1800 r.p.m. motor
Pattern shop drive	10 h.p.,	1800 r.p.m. motor
Draw shaper	10 h.p.,	1800 r.p.m. motor
Machine shop drive	7½ h.p.,	1800 r.p.m. motor
Test machine	5 h.p.,	1800 r.p.m. motor
Higley saw	5 h.p.,	1800 r.p.m. motor
Core machine	1 h.p.,	1800 r.p.m. motor
Portable centrifugal pump	2 h.p.,	1800 r.p.m. motor
Dry grinders (2) each	7½ h.p.,	900 r.p.m. motor
Carpenter shop	10 h.p.,	1800 r.p.m. motor
Restaurant oil burning system.....	1 h.p.,	900 r.p.m. motor
Portable mold dryer	¼ h.p.,	1800 r.p.m. motor
Portable riddles, (2) each	¼ h.p.,	1200 r.p.m. motor
Lifting magnet motor generator...	7½ h.p.,	1800 r.p.m. motor

Cranes.

The two cranes are each of 60 ft. span, one being of 30 tons capacity, the other 10 tons. The larger crane is used for the heavy work, pouring, etc., and is fitted with a 30 h.p., 1200 r.p.m. motor on the main hoist giving a hook speed of 12 ft. per minute. The auxiliary hoist is fitted with a 22 h.p., 1200 r.p.m. motor, giving a hook speed of 50 ft. per min.

The trolley is operated at a speed of 100 ft. per minute by a 7½ h.p. motor, 1800 r.p.m. and the bridge, 200 ft. per minute by a 30 h.p. motor, 1200 r.p.m.

The smaller crane is used for the lighter work, including castings, flasks and molds, and is fitted with a 22 h.p., 650 r.p.m. motor for the hoist giving a hook speed of 20 ft. per min., a 22 h.p., 1200 r.p.m. motor on the bridge giving a speed of 325 ft. per min. and a 4 h.p., 1200 r.p.m. motor giving a trolley speed of 100 ft. per min. All the above motors are variable speed, 440 volt, three-phase and are controlled by drum type controllers in the operator's cage. All of the hoists are fitted with safety limit switches, mechanical and electrical brakes.

In addition to the above cranes there are two trolley hoists each of two tons capacity, with a lifting speed of 10 ft. per min. and fitted with a single 3 h.p. motor, operated from the floor by ropes.

Charging Machine.

The charging machine is of the Wellman type, consisting of a heavy structural steel frame work carrying a reversible trolley upon which is mounted the charging head. The machine is used for placing the charges of raw material in the open hearth furnace and is operated by four variable speed, three-phase motors with drum controllers. The structure travels on a track paralleling the front of the furnace and on a level slightly below the charging doors.

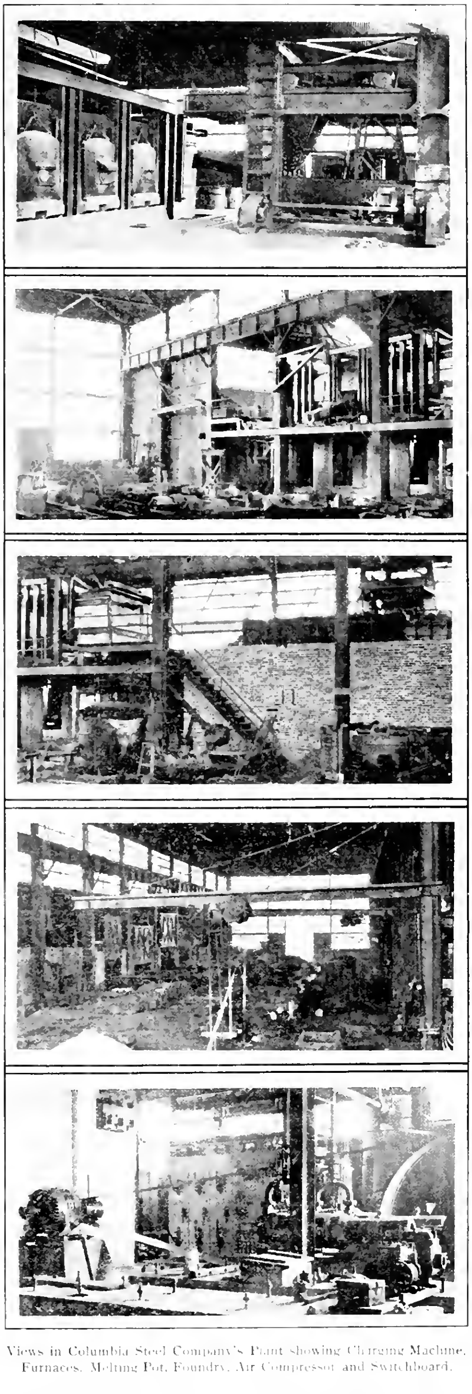
The raw material, stacked in specially constructed steel hoppers, is hauled up to the charging platform on cars. The hoppers are then picked up, one by one, by the charging head which can be racked in or out and revolved. After the charging door is opened, the head is run in and tilted, distributing the raw material over the bed of the furnace. By the use of this machine a large amount of material can be charged in a short time, by one man and a helper, without allowing an excess of cold air to enter the furnace. Three of the motors are of 22 h.p. at 675 r.p.m. and the other 7½ h.p. at 1080 r.p.m.

Peel Machine.

This machine is used for transferring special steel castings from the annealing furnace to the quenching pit and consists of a car carrying a special form of scoop or shovel so arranged as to be run in under the castings, raised, withdrawn, run over the quenching pit and the castings then dropped into the pit. The peel machine is operated by two 7½ h.p. variable speed motors with drum controllers.

Electric Welding Outfit.

The electric welding outfit consists of a special direct current generator coupled to a three-phase induction motor, automatic controlling device and carbon electrode. The generator has a rated capacity of 500 amperes at 60 volts but in practice it is frequently operated at 80 volts and up to 600 amperes.



Views in Columbia Steel Company's Plant showing Charging Machine, Furnaces, Melting Pot, Foundry, Air Compressor and Switchboard.

A bank of low value cast grid resistances controlled by two switches makes it possible to obtain current values from 170 to 600 amperes, in four steps which cover all practical requirements. As an ex-

ample of what can be accomplished by the use of the welder it might be interesting to note that large gates or risers having a cross section of about 5x7 in. can be burned off and the casting smoothed in one sixth the time required to set the casting and cut the gate off in a cold saw or draw shaper.

Lifting Magnet Outfit.

This consists of a 43 in. magnet operated by a motor generator set in the power house. The magnet has a maximum capacity of 10 tons and is used for lifting the scrap breaker ball, unloading and loading cars, castings and scrap. It is used either on the traveling locomotive crane, the foundry cranes or at the scrap breaker hoist. Current is supplied through a flexible cable, plugged in at any one of the various waterproof outlet boxes, conveniently located around the works and supplied from an underground feeder.

Lighting System.

Current for lighting the buildings and supplying the small motors is supplied from three single-phase, 5 kw. transformers, one across each phase. The transformers are placed at the centers of distribution and are fed from the 440 volt power mains. The secondaries connect to distributing panels, from which the various circuits are lead to the lamps. For lighting the foundry, generally, flaming arcs, 500 watt and 100 watt tungstens are used, while over the core benches and for portable lights carbon filament lamps fitted with guards or Holophane steel reflectors are installed.

The offices, club rooms, dining rooms and lavatories are lighted by tungsten lamp units of 100 watts each while the pattern loft, pattern shop and sleeping rooms are lighted by carbon filament lamps.

The entire lighting system is installed in conduit and has passed through the breaking in stage without any trouble whatsoever.

Telephone System.

An intercommunicating telephone system with 11 stations has been installed, using lead covered cable throughout. Communication is established between the offices, pattern loft, pattern shop, foundry, charging floor, engine room, chemical laboratory, shipping department, store room and living quarters. Telephones are of either the desk or wall type, the latter being incased in enameled steel boxes. Both the ringing and talking circuits are operated from a central battery and conversation can be carried on between five pairs of stations simultaneously. The entire installation has been carried out by the Columbia Steel Company's own force under the supervision of the writer.

FUEL OIL FOR THE NAVY.

The California State Mineralogist, L. E. Aubury, in conjunction with a large number of producers, is conducting an energetic campaign to have oil fuel adopted by the United States Navy instead of coal. On April 5th a strong memorial was sent to the Secretary of the Navy in which the permanency of supply is assured and its economical advantages detailed. California oil can be laid down at Puget Sound at a cost of 90 cents per barrel, at Mare Island for 80 cents, and at Honolulu for $1.20, under large contracts.

OIL BURNING.

BY E. N. PERCY.

(Concluded.)

It has not been possible to use a refined type of burner in the ordinary apparatus for the generation of illuminating gas from oil, because the tips burn off. Hence fires are maintained with the crudest possible type of pipe burner, yet giving excellent results. Crematories and glass furnaces requiring high temperatures are operated on the regenerative system, whereby the waste products heat a stove during one cycle foot and during the other the draft is returned through this stove and reaches the furnace in intensely superheated.

There have been many efforts to solidify oil or to use it as the principal constituent of a briquette for domestic purposes and several such enterprises have failed. Supposing that in some manner the oil itself could be used in the home, it is hardly conceivable that a briquetting company operating on any scale could reach the consumer except through the dealer. The basic price is approximately $1.00 a bbl. and it takes four bbl. to equal a ton of coal. Dealers are not paying much more than $4.00 to $6.00 for coal which is delivered to the consumer for $15.00 to $20.00. Since crude oil in retail quantities, with the expense of delivering, storage, etc., costs almost as much as the coal, it can be seen that there is little or no margin for profit in this business. Furthermore large bodies of peat, lignite and coal lie undeveloped at several points in the West, not because of any deficiency within themselves, but because the Western market is so small and covers so large a territory.

Furnaces.

There are many ways of preparing any common boiler to burn oil but a comparatively few principles to be observed in accomplishing it successfully. Fig. 30 shows a tunnel fired boiler with fire in front. Fig. 31 shows a tunnel fired boiler with fire in back. Either one works fairly well under heavy load, especially if a conical flame be used, but under light load when the flame is cut to minimum proportion there will always be an excess of air coming in from the top of the flame and most tunnel fire boilers show an excess of air under any conditions. It has been found that tunnel boilers equipped as in Fig. 31 make trouble through the frequent failure of the arches.

Fig. 32 shows an old style method of firing a boiler with a target which was considered necessary to properly ignite the oil and in point of fact was necessary in the days when atomization had not been reduced to the science that it is now. At the present stage of development any oil burning expert would not accept a burner which would fail to maintain a suspended flame clear and smokeless in a cold furnace. Fig. 33 shows another method of firing a return tubular boiler. This method is now little used, it being merely another form of the target.

Fig. 34 and 35 show still other methods, the objection to either of them is that a heavy fire would be very apt to strike the middle of the boiler. Fig. 36 shows a return tubular boiler equipped for oil burning according to the best current practice. Fig. 37 shows one method of firing water tube boilers. Figs. 38, 39 and 40 illustrates still other methods for various boilers.

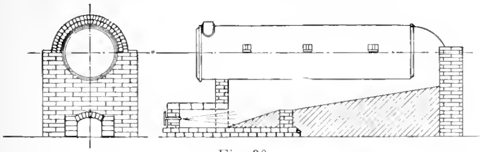


Fig. 30.

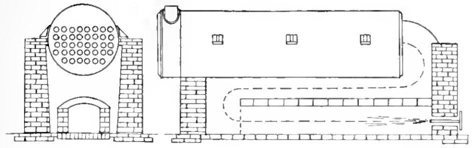


Fig. 31.

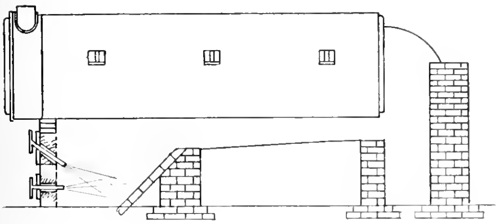
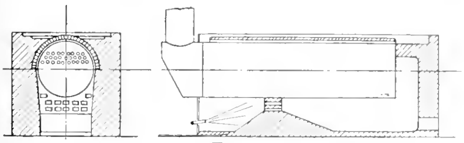


Fig. 32.



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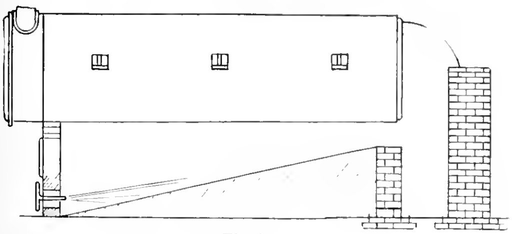

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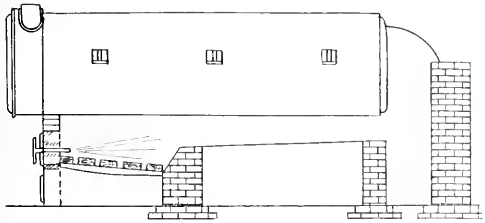

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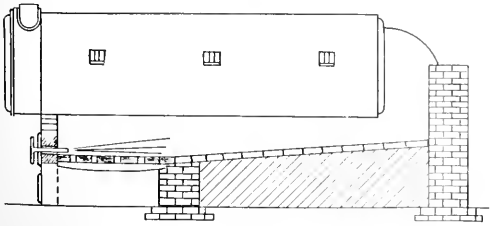

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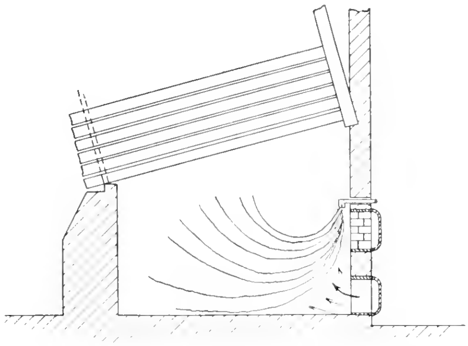

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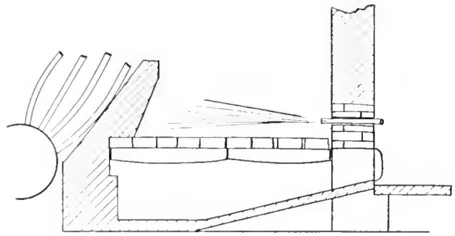

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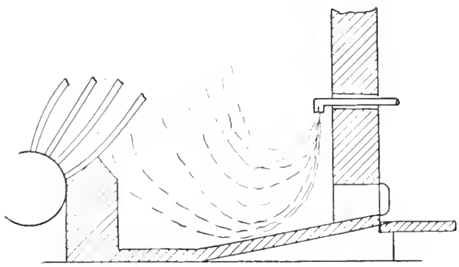

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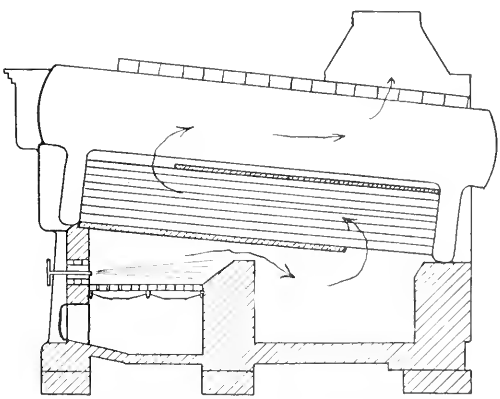

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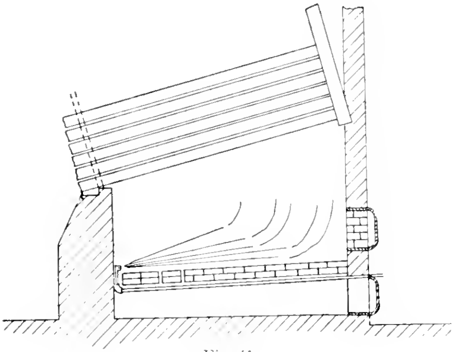

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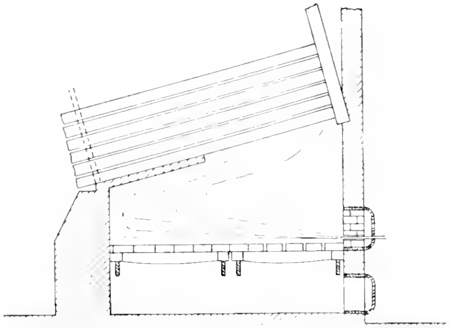

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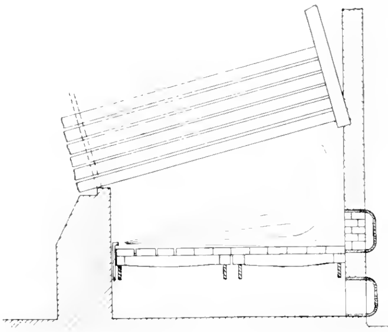

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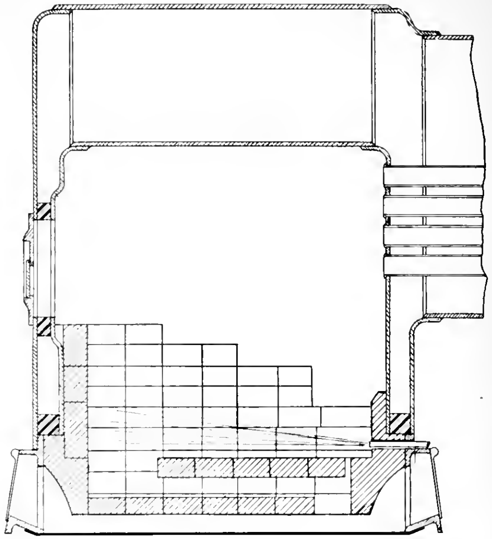


Fig. 44.

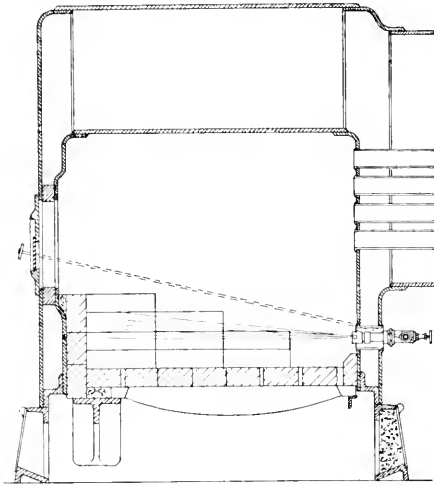


Fig. 45.

Fig. 41 shows the arrangement and general draft lines of a forward shot B. & W. boiler. Fig. 42 shows a back-shot B. & W. boiler with bricked up grates. Fig. 43 illustrates a back-shot B. & W. boiler especially bricked up for oil firing. There has been much discussion about these arrangements because the B. & W. boiler is so widely and generally used and the writer refrains from comment.

Fig. 44 is a frequent arrangement for locomotive boilers which has been quite successful, after many experiments in which much damage has been done, but there is at the present time no representative or accepted method recognized as the best arrangement for locomotives.

Fig. 45 shows another arrangement of locomotive boiler that has been found quite successful by a well known smelting company who operate their own locomotives. Fig. 46 shows three views of another arrangement in successful actual use. Fig. 47 and 48 show still others.

Fig. 49 is an internal fire boiler with a round burner which is shown here with the end bricked up and a conical flame. Most Scotch boilers were arranged in this manner in the early days of oil burning. Now many of them are arranged with the flat flame and long draft as shown in Fig. 50.

As a matter of fact, in practice, a conical burner never throws a true conical flame, the lower side is always distorted and the upper side driven against the boiler by the up-rush of the heat against the air or

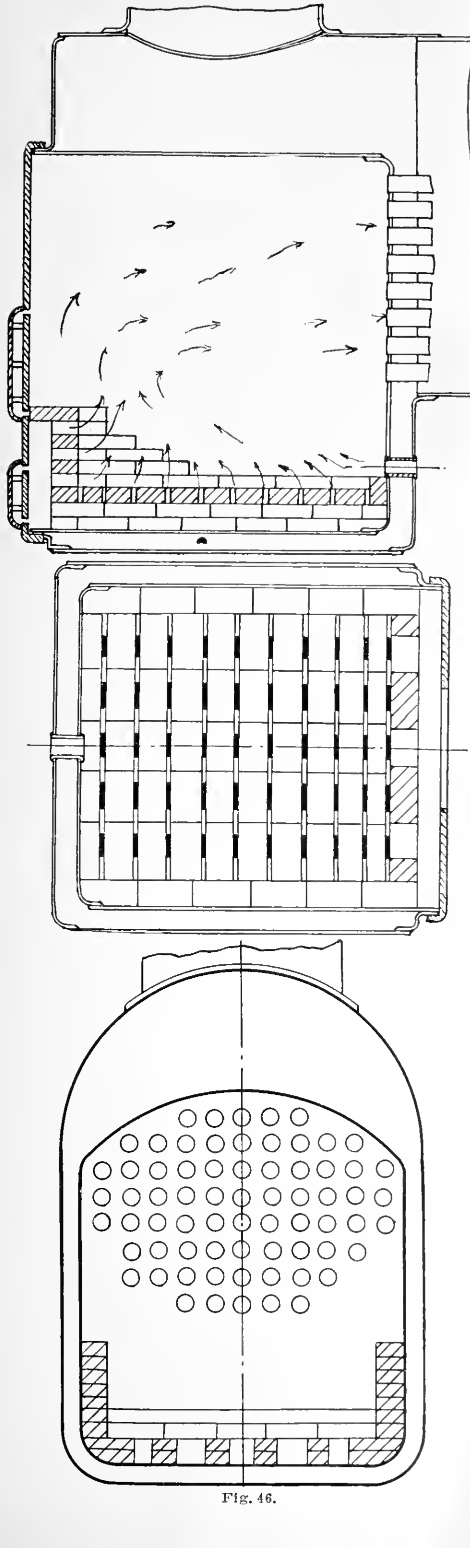


Fig. 46.

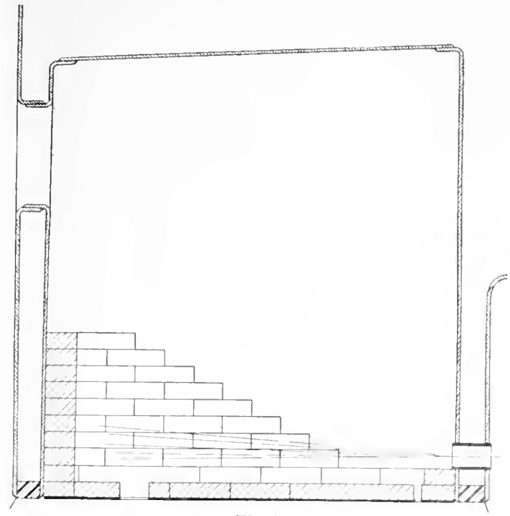


Fig. 47.

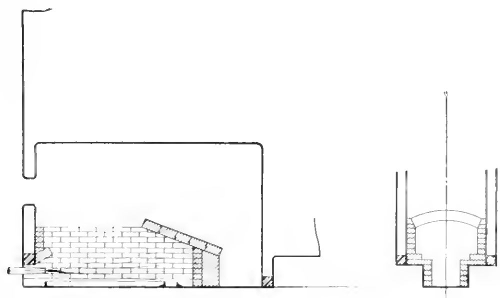


Fig. 48.

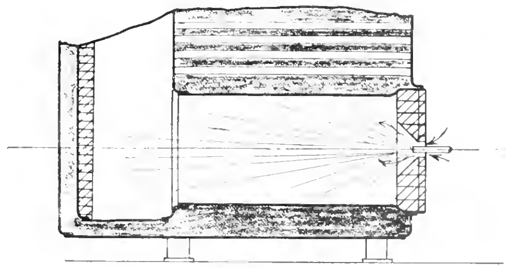


Fig. 49.

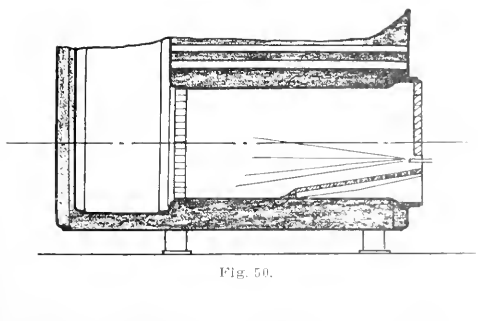


Fig. 50.

if the burner is so adjusted that this is not the case then cold air passes round the burner up over the fire as it becomes heated and escapes without being burned, unless the fire is heavy enough to fill the burner. Still with proper arrangement there are many places where the conical fire is more suitable than the flat flame. The greatest trouble with the flat flame is that engineers will not trim their burners so as to bring the shoulders of the flame well forward in the corners of the burner at right angles to it. The steam burner is fairly well understood but the air burner has many possibilities which have not as yet been thoroughly investigated.

Low pressure air of from 2 to 10 lb. has many possibilities heretofore unrecognized. Burners for cooking stoves and ranges were never satisfactory until low pressure air was used, since which time they have been made to operate most successfully in many places. Low pressure air furnished by a rotary blower is used for most industrial work, for cement burners, procelain, reverbatory copper burners and other. In some industries it is quite common for an oil burner to throw a flame ten or more feet in diameter and 120 ft. long, low pressure air only being used for atomization.

Every color of the rainbow can be found in an oil flame, each of which has its own meaning. In a general way an oil flame is supposed by practical men to be doing its best work when it is of a beautiful pink color, if it be duller than this it will smoke and if it be brighter it will burn the brick and is generally indicative of an intense combustion arising partly from an excess of air. When the oil is highly heated and the steam and air are likewise the flame is apt to star, that is to have the appearance of being filled with small sparks as though iron filings were present. Various explanations are given for this but the result is a decrease in economy and a deposit of carbon.

When an oil flame of this fish-tail variety is working close to an incandescent brick floor it will tend to drop towards the brick as though heated up, and should it touch the brick, instead of obeying the law for angle of incidence and reflection it will strike upwards at a sharp angle directly into the boiler. Tearing of the flame is due entirely to too much draft cutting in at one point, as pointed out in a previous figure.

Puffing or vibrations of the fire is due invariably to the form of the burner near the tip, it being such that small quantities of oil gather in the spoon shaped cavity just back of the tip and when the oil is at low pressure these particles are ejected in varying quantities. With lime kilns and some forms of metallurgical furnaces in which it is desirable to have a large flame plume without too intense combustion it is customary to mix part of the stack gases with the draft, whereupon the fire will immediately soften and decrease in intensity.

Some brick yards make use of a long thin fire known as a rat-tail, the burner being on a hose so that it can be moved from point to point. In fact, there are at times several burners. The ordinary bake oven as used in our large bakeries would make some mechanical engineers sit up and take notice. It consists of a combustion chamber and a bake chamber; between the two is a fire wall perforated by pieces of four inch hydraulic pipe. This pipe has each end hermetically sealed and the fire is applied to one end and the baking done at the other. Circulating water, quite possibly, at enormous pressure carries the heat from one end to the other, never escaping and never bursting the pipe.

The approximate cost of the equipment for a 600 h.p. oil burning plant may be gathered from the following table:

2 duplex pumps, 4½ x 2¾ x 4 in.	$140	1 240-bbl. oil tank, f.o.b. San Francisco	$390
1 relief valve	10	Foundation for same	125
1 air chamber	6	1 380-bbl. oil tank, f.o.b. San Francisco	480
1 oil heater	60	Foundation for same	150
4 oil burners	80	1 500-bbl. oil tank	900
Firebrick per M	30	Foundation for same	250
Piping, valves, etc.	100		
Labor, etc.	200		
	$620		

A 100 h.p. plant should be installed by a clever engineer at a cost not greatly exceeding $200 if he makes an oil heater from pipes.

A NEW FUEL FOR EGYPT.

Experiments for the manufacture of the new fuel produced from the sudd of the Nile have been taking place at Meresburg, in Germany, in which British capital (chiefly) is aided by German science. These experiments are the direct outcome of the foresight of Lord Cromer, and of his equally far-seeing colleague, the Governor General of the Sudan, Sir Reginald Wingate. One of the greatest difficulties with which the pioneers of the Sudan have had to contend has been the constant blocking of its natural highway, the Nile, by masses of weedy growth, commonly spoken of as sudd. For a distance of 300 miles the Nile runs through a huge morass, estimated to cover 35,000 square miles, which is known as the sudd district. Throughout the length of this reach it is impossible to secure fuel of any kind, as the river channel has no banks, in addition to which, during the rainy season, when gales are frequent, large masses of sudd break away and block up the channel, rendering it unfit for and even dangerous to navigation. Lord Cromer realized what a serious factor this was in the retardation of the development of the Sudan, and it was a suggestion of his contained in one of his reports that led a German diplomatist, Herr vom Rath, to conceive the idea of utilizing this material in the form of a cheap local fuel. The price of coal being as high as 66s. ($16) per ton, and wood very little cheaper, encouraged the suggestion.

Negotiations were entered into with Sir Reginald Wingate, and small consignments of sudd were dispatched by the Sudan Government to Berlin for experimental purposes. The results of these experiments were so far satisfactory that further negotiations were undertaken with the Sudan Government. A considerable quantity of sudd was cut and brought back to Europe, and it was with the object of seeing this material converted into fuel that the experiments at Merseburg have been arranged. The process is very simple. The sudd is first dried and then put through a disintegrator, from which it emerges in an almost powdery form, when it is converted into briquets. The time occupied from the moment the sudd enters the disintegrator to the time it emerges as a briquet is only a few minutes. The heating value of the new fuel is nearly two-thirds that of coal, while the briquets themselves have a density of four-fifths that of coal.

NEW STEAM PLANT OF SOUTHERN CALIFORNIA EDISON COMPANY.

BY H. W. DENNIS.

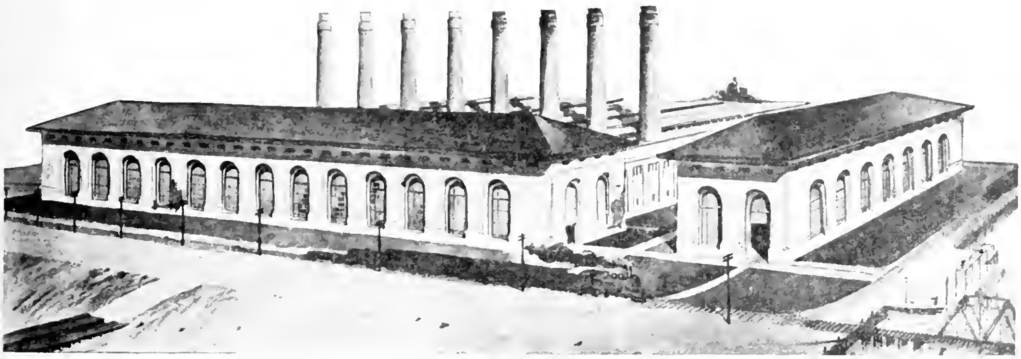
The Southern California Edison Company is now engaged upon the construction of a power station at Long Beach, Los Angeles County, California, wherein there will be installed a 12,000 kw. steam turbine unit. The new station will operate in conjunction with the company's other plants of which there are six hydraulic developments and one other major steam auxiliary supplying power in the counties of Los Angeles, San Bernardino, Riverside and Orange. It is not known at this time what will be the ultimate capacity of the station, although the present buildings and foundations are designed to provide for a duplicate of the equipment which the company is about to install. It may be said, however, that the general layout is on the "unit" system, so that the plant may be extended indefinitely as such extension becomes justifiable, and with this in view the company purchased a parcel of land comprising about 10 acres. The site is considered to be a most advantageous one for many reasons, principally, however, on account of its location which borders on the entrance to what is known as the Long Beach Inner Harbor. This channel will therefore provide water for condensing purposes, supplying all of the ocean water which will be required, and the controlling works will not be subjected to the violence which would be invited if they were located on the open beach.

The present construction for this steam station will comprise two buildings having a combined floor space of nearly an acre. The generator and boiler house will have a floor area of 30,000 square feet and will be 60 feet high, while the building which will contain the electrical switches and transformers will cover 7600 square feet and will be four stories in height. Both structures are to be of reinforced concrete with artificial stone base, ornamental copper cornice and mission tile roof. The generator room will have a floor of imported Welsh quarry tile, with a glazed tile wainscot. Everything considered this will be the handsomest and best equipped steam plant west of Chicago.

For supplying the steam for this turbine and its accessories, there are 8 Stirling boilers, each of which will deliver continuously 30,000 lb. of steam per hour at 225 lb. pressure, and 125 degrees super-heat. For the entire present installation this evaporation is at the rate of 2880 tons of water per day, an amount equal to that contained in an 8 in. water main 50 miles long.

After doing its work in the main turbine, the steam passes into the condenser, where it is converted again into water, a process which not only provides better economy in operation, i. e., more power per pound of steam used, but saves most of the water, which is then returned to the boilers to be again evaporated.

The circulating water for cooling the surfaces with which the steam comes into contact is to be salt water pumped from and returned to the Inner Harbor. The condenser itself is an immense cast iron shell containing over nineteen miles of brass tubing through which the salt water "circulates." The entire circulating system makes use of the principal of the syphon so that the pumps have to overcome only the friction in the condenser, and in the pipes between the intake conduit and the outfall conduit.



New Steam Plant of Southern California Edison Company

Crude oil will be used for fuel, and a large storage tank of concrete will be provided. Auxiliary tanks will be located adjacent to the boiler room so that the oil pumps for each unit may be relatively near their source of supply. The oil will be received either in tank cars or through an oil main which passes the company's property.

The switchboard from which all of the machinery and switches will be controlled, is to be situated in the generator building, although the transformers and switches are to be installed in the transformer house. Electricity will be generated at 11,000 volts and a part of the current will be distributed at this voltage, although the transformers will provide for transformation to 30,000 volts and 60,000 volts, and the long distance transmission will be accomplished at the latter voltage. Double bus bar systems are provided throughout for 11,000, 30,000 and 60,000 volt circuits.

Mr. Frederick Sargent of Chicago has been retained as consulting mechanical engineer. The Southern California Edison Company's engineering department is supervising the construction work and has made all of the designs and plans except the purely architectural details which were designed by Parkinson and Bergstrom of Los Angeles, who have been retained as consulting architects.

CORPORATE ORGANIZATION AND COMBINATION.

There is nothing of greater common interest, nothing which is exciting more comment and discussion at the present moment, than the questions of state control of corporate organizations and of combinations, especially of those controlling public utilities. These are discussed by a writer in the annual report of the American Telephone and Telegraph Company as follows:

Corporate organization and combination are the necessary and logical solution of the problem of caring for the wonderful development which has been going on all over the world, and particularly in this country, in the recent past.

Combination only can cope with that industrial development of the present time which is far beyond the scope of individual effort or capital. In those good old times, one man, with his own capital, could carry on even the largest operations. The margin of profits due to low wages and large selling prices enabled the owners of such individual establishments to live and enjoy the best to be had in those times, and amass fortunes—fortunes relatively as large as any of the present—from an amount of gross business, the profits from which today would not be sufficient to pay the wages of a shop superintendent.

The development of the arts, the necessity of extensive laboratories and experimental departments, with technical staffs competent to keep abreast of modern progress and find out how to utilize all of everything, the large gross production at small margin of profit, the large capital requirements necessary to conduct business on these lines; all these place modern industrial enterprises either beyond the financial ability of any one individual, or far beyond the amount that any one individual wishes to have in any one venture.

Without attempting to discuss the history or evolution of "Company," "Corporation," or "Monopoly," and similar organizations or combinations of trade, it can be said that the first and oldest step towards corporate organization was partnership. Corporate combination is but a partnership wherein the partners are represented by shares held in various amounts by the various investors.

These corporate organizations and combinations have become a permanent part of our business machinery; the public would not, if it could, abolish them.

Who would ever consent, or would the requirements of business allow, that the railroads between the great sections of our country revert to the independent lines that once existed, with all the consequential delays, inconveniences and disadvantages to traffic and travel? Who would be content if the telegraph business should be carried on by the transfer of messages from one to another of the numerous companies, formerly independent, but now combined and giving direct transit over the whole country?

That there has been in large measure reason or cause for the existing unfavorable public opinion as to corporations, trusts and combinations, is beyond question, but it does not follow that there is reason or cause for the wholesale denunciation and condemnation of all corporations, trusts and combinations. Nor does it follow that all that is bad is centered in or confined to those prominent in the public eye.

Many of the practices most severely condemned are but the amplification or continuance of practices or customs common in the current affairs of business, practices or customs which were not wrong in themselves, but wrong in the abuse of them.

Public utility corporations and other combinations have too frequently assumed that new laws and regulations were disastrous and ruinous without first giving them a fair trial, and legislators too often have displayed an ignorance or disregard of existing laws, spreading the idea that new legislation was a cure-all for any undesirable condition, while it was often only a political play, and the enforcement of the existing laws was utterly neglected. The results have been bad. While business will adjust itself to any condition if given time and opportunity, sudden change of conditions will result in disaster to some interests, but not as a rule to those at which the change was aimed.

There is too little consideration given to the fact, based on all experience, that no one interest can permanently prosper unless all other interests are in a prosperous condition, and to the fact that any sudden change in existing conditions will always be taken advantage of by some one interest to the detriment of other interests in general.

The proper use of corporate organization or combination under proper regulation or control cannot be objected to.

What is and should be condemned, prevented and punished, is the abuse made of corporate machinery to the detriment of public welfare and such abuse as has been and is being practiced so extensively for purely speculative and oftentimes swindling enterprises.

It is largely this abuse by professional speculative promoters and swindling security vendors, mostly on a comparatively small scale, not in any way associated or connected with the general business organizations or systems, that has been the cause of most of the popular odium surrounding this necessary machinery of business. It does not seem possible that the only way of reaching such offenders is through penalties for "misuse of the mails," but however or by whomever the remedy is applied, he who does it should receive the heartiest thanks and appreciation of the community.

The large corporate combinations which often in popular opinion are supposed to be owned or wholly controlled by some one man or some few men, are, in fact, made up of thousands and tens of thousands of silent partners, the shareholders, who are the real owners. The existence of these real owners, these shareholders, is often obscured in the shadow of some one or more individuals who dominate these companies, not by large ownership, as popularly believed, but by administrative and operating aggressiveness and successful management. The shareholding owners are in the aggregate very numerous and, in any other country than America, would be frequently in evidence and heard from, would always take an active participation in all meetings, annual or special, and would in that way protect themselves and their

holdings by associating the corporation or combination in the minds of the public with the particular and separate individual ownerships, or interests in them. In this way that same protection, recognition or consideration, to which all interests, whether individual or corporate, are alike entitled, would be assured.

Public Utilities—The "Served" and the "Servers."

Under the existing conditions the corporations or combinations represent the "servers." To the shareholders, dividends represent good management and desirable investment, but to many of the community, the community that is "served," profits which in individual enterprise would be considered reasonable are unreasonable and forced out of their pockets by unscrupulous management or illegal or dishonest practices.

The contest between the "served" and the "servers," the "producer" and the "consumer," between "he-who-has" and "he-who-has-not," has been going on from the dawn of civilization, from the time when some one had more of some one thing than he wanted, while another had none, or less than he wanted.

From time immemorial efforts have been made in some way to control or restrict any accumulation, in the hands or in the uncontrolled possession of any individual or set of individuals, of those things which had become necessary to public wants, and to prevent necessities from in any way getting outside that control which natural competition, or the law of supply and demand under normal conditions exercises.

There has always been and will always be the laudable desire of the "server," or the producer, to get and as cheaply as possible, which sometimes selfishly degenerates into a lack of consideration for the rights of those who are serving.

On the other hand there has always been the laudable desire of the "service," or the producer, to get a profit for his service or production, which sometimes degenerates into a selfish disregard or lack of consideration for those who are served.

This conflict, which originated with the first commercial transaction or exchange, has continued ever since and will continue to the end of time.

Until the state, or conditions under which society was organized, began to be complex there were very few things which were not and could not be regulated by the law of supply and demand, the law of substitution of one article for another in case of scarcity, or by the laws of competition. In the simple life, which was with the masses of the people until very recent years enforced, and is with all laudable, there were few articles which were in themselves necessities, and of these very few which did not have alternative articles of use, or substitutes, and, in fact, there was little that was not produced by the local community or by the family. Those few things which, in the growth of civilization, and particularly by the increase of urban population, were of general use and necessity for all, those few things in which the masses of the public had an interest in receiving regularly and reasonably, soon became the object of control or regulation, and here was the beginning of and reason for State control and regulation or State ownership.

Public Control.

Public control or regulation of Public Service Corporations by permanent commissions, has come and come to stay. Control or regulation exercised through such a body has many advantages over that exercised through regular legislative bodies or committees. The permanent commission will be a quasi-judicial body. It should be made up of members whose duty it will be, and who will have the desire, the time and the opportunity, to familiarize themselves with the questions coming before them. It should act only after thorough investigation and be governed by the equities of each case. It would in time establish a course of practice and precedent for the guidance of all concerned.

Experience also has demonstrated that this "supervision" should stop at "control" and "regulation" and not "manage," "operate" nor dictate what the management or operation should be beyond the requirements of the greatest efficiency and economy.

Management or operation requires intimate knowledge and experience which can only be gained by continuous, active and practical participation in actual working, while control or regulation can be intelligently exercised, after judicial hearing, by those who have not the knowledge or experience to operate.

State control or regulation should be of such character as to encourage the highest possible standard in plant, the utmost extension of facilities, the highest efficiency in service, rigid economy in operation, and to that end should allow rates that will warrant the highest wages for the best service, some reward for high efficiency in administration, and such certainty of return on investment as will induce investors not only to retain their securities, but to supply at all times all the capital needed to meet the demands of the public.

Such "control" and "regulation" can and should stop all abuses of capitalization, of extortion or of overcharges, of unreasonable division of profits.

If there is to be State control and regulation, there should also be State protection—protection to a corporation striving to serve the whole community (some part of whose service must necessarily be unprofitable), from aggressive competition which covers only that part which is profitable.

Governmental control should protect the investor as well as the public. It should ensure to the public good service and fair rates. It should also ensure fair returns to the investor.

A public utility giving good service at fair rates should not be subject to competition at unfair rates.

It is not that all competition should be suppressed but that all competition should be regulated and controlled. That competition should be suppressed which arises out of the promotion of unnecessary duplication, which gives no additional facilities or service, which is in no sense either extension or improvement, which without initiative or enterprise tries to take advantage of the initiative and enterprise of others by sharing the profitable without assuming any of the burden of the unprofitable parts or which has only the selfishly speculative object of forcing a consolidation or purchase.

State control and regulation, to be effective at all, should be of such a character, that the results from the operation of any one enterprise would not warrant the expenditure or investment necessary for mere duplication and straight competition. In other words, the profits should not be so large as to warrant duplication of capitalization in the competition for the same business.

When thoroughly understood it will be found that "control" will give more of the benefits and public advantages, which are expected to be obtained by State ownership, than could be obtained through such ownership, and will obtain them without the public burden of either the public office-holder or public debt or operating deficit. It is conceded that as a rule private management is better, more economical and more efficient than public management, and much more advanced and enterprising. The economical margin between public and private management has been shown by experience to be more than sufficient to secure the best private administration.

When through a wise and judicious State control and regulation all the advantages without any of the disadvantages of State ownership are secured, State ownership is doomed.

State control of public utilities should not prevent progress, should be sufficiently unrestricting to encourage the introduction and demonstration of the value of any new or novel enterprise, and should allow sufficient reward for the initiative, enterprise, risk and imagination of the adventurers behind such enterprises. It should discriminate between the useful adventurers or promoters, pioneers in fact, and those pirates or sharks who, on the strength of other successes, extravagantly capitalize undeveloped ideas, and exchange the worthless securities for the savings of deluded and credulous investors. Corporate control and restriction should always exist to a sufficient degree to prevent such speculative promoting, and such stock-jobbing schemes.

The regulation or control of any new or novel thing which is a mere convenience and not a necessity can be left largely to the laws of trade; such a thing, if offered, much be offered at a price acceptable to the public, who are the customers, at a price which in the opinion of the purchaser leaves him a margin of profit either in convenience or enjoyment. Under such control private initiative can be depended upon for the introduction of everything believed to have possibilities.

The combination of the promoter, investor and capitalist, with their imagination, personality, optimism and desire, has been at the bottom of every development of every kind or nature which has benefitted the human race in the way of utilities, and still is the only way in which new utilities can be developed. Whenever any great works have been undertaken by governments they have been on lines of old development, based on experience of that which has been developed by the persistent genius and application of some individual or group of individuals.

State control or regulation, to be effective, should when exercised, be accepted and acquiesced in by the public. If all the decisions not in exact accord with the desire or contention of the public are condemned, if it is expected and required that all decisions be against the utilities controlled, if politics and political effect are to govern decisions, if decisions go for nothing with, and are not respected by the public, failure and disappointment are bound to follow, self-respecting men will refuse to act, the standard of appointments will fall and State control and regulation will become a disgrace, and the evils which it was intended to correct will multiply.

If any company gives good service, meets all the reasonable demands of the public, does not earn more than sufficient to provide for the maintenance of its plant up to the latest standard and for reconstruction of plant when worn out or obsolete, pays only fair dividends to its shareholders—if a company is only doing this its rates and charges to the public cannot be unreasonable.

Competition vs. Control or Regulation.

Effective, aggressive competition, and regulation and control are inconsistent with each other, and cannot be had at the same time.

Control or regulation, to be effective, means publicity; it means semi-public discussion and consideration before action; it means deliberation, non-discrimination; it means everything which is the opposite of and inconsistent with effective competition.

Competition—aggressive, effective competition—means strife, industrial warfare; it means contention; it oftentimes means taking advantage of or resorting to any means that the conscience of the contestants or the degree of the enforcement of the laws will permit. To make competition effective great and uncontrolled latitude of action is necessary; action must be prompt and secret.

Aggressive competition means duplication of plant and investment. The ultimate object of such competition is the possession of the field wholly or partially; therefore it means either ultimate combination on such basis and with such prices as will cover past losses, or it means loss of return on investment, and eventual loss of capital. However it results, all costs of aggressive, uncontrolled competition are eventually borne, directly or indirectly, by the public.

Competition which is not aggressive, presupposes co-operative action, understandings, agreements, which result in general uniformity or harmony of action, which, in fact, is not competition but is combination, unstable but for the time effective.

Fluorescence and phosphorescence, according to Professor W. D. Bancroft, are due to light emissions caused by chemical changes produced by ether waves. Fluorescent materials have been generally accepted as frequency changes of ether waves, and Prof. Bancroft's theory, which is amply confirmed by experiment, has aroused much interest among scientists.

Wireless telegraphy in mines has been the subject of investigation by German electrical engineers, who have succeeded in communicating through 250 yards of solid rock at the Hercynia salt works at Vienenburg and through 600 yards between adjoining mines with the receiver at the bottom of a 250 ft. shaft. This indicates that wireless communication through the earth's crust will be an event of the not far-distant future.

LOCOMOTIVE PRACTICE IN USE OF FUEL OIL.[1]

BY HOWARD STILLMAN.

About the first practical use to which fuel oil was applied as a means of generating steam in California was by the Central Pacific on a locomotive between Sacramento and Davisville. It was a comparatively thin oil of a reddish color and I think was a foreign product. The experiments were made to see if it were possible to make a locomotive steam with oil fuel. Results were quite satisfactory, but as the price was considerable the matter was dropped. The first regular conversion of a locomotive to oil burning in regular service was in November, 1900, and a number of tests were made in comparison with coal fuel that proved so satisfactory that in February, 1901, we were authorized to equip other engines. This was gradually done, and in about five years all locomotives were converted to oil burners. The approximate number of locomotives the Southern Pacific Company now have burning oil is as follows: Passenger, 396; freight, 455; switch, 140; total, 991.

On the above basis the monthly consumption is 677,875 barrels per month, or 8,134,500 barrels per year. These figures were for about six months ago and are slightly exceeded at this time. I am referring only to the Southern Pacific Railroad in California and extending to El Paso, Texas, embracing what are known as the Calvin lines.

The characteristics of the oil we burn have been fully covered in papers before you at the last meeting. There is of course a slight variation in gravity ranging from 14 to 15 Beaume. Its calorific value is taken at 18,500 B.t.u., which we consider as expressing its heat value. In various determinations that have been made, a slight variation in B.t.u. is found in the same sample by different observers. I think that Professor Le Conte's Fig. 1 well expresses a range of results that can be obtained with oils of the same gravity.

The following specifications for fuel oil has been adopted by the Southern Pacific System:

General Requirements.

This oil or "liquid fuel," is crude petroleum as received from the wells, or the product of crude petroleum, distilled or reduced. It must contain no sand or foreign matter in shape of sticks, waste, stones, etc., and must be sufficiently liquid to flow readily in 4-inch pipes at a temperature of 70 degrees Fahrenheit. It must contain as little water as possible, and oil containing more than 2 per cent of water and other impurities will not be accepted. Fuel oil will be paid for on basis of volume at 60 degrees Fahrenheit, also deducting all water contained, according to method outlined as follows:

Tests.

One sample will be taken from each carload or fraction thereof. The sampling of cars is to be made with car thief having valve at lower end. The thief with open valve will be lowered gradually into car and valve closed at instant of touching bottom. The thief thus filled will contain oil sample to be tested for water, sand and B. S. Oil received in settling or storage tanks will be sampled with Robinson or other standard thief, a sufficient number of samples being taken to secure an average of its contents.

1. Fuel oil will not be accepted for general use whose flash-point is less than 110 degrees Fahrenheit when tested by the open cup, Tagliabue method. The oil to be heated at rate of 5 degrees per minute, and test-flame applied every 5 degrees, beginning at 90 degrees. The above flash-point being the danger point at which the oil begins to give off inflammable gas, the fire or burning point is not required.

2. The test for water, sand and B. S. will be made as follows: 100 cubic centimeters of the sample will be placed in a 250 cubic centimeter graduated glass cylinder provided with stopper, and thoroughly shaken up with not less than 150 cubic centimeters of gasoline. The mixture will be heated to 120 degrees Fahrenheit for from 3 to 6 hours to facilitate the separation of impurities, the amount of which can then be read from the graduations of cylinder. All proportion of water and other impurities contained in the sample will be deducted from the volume contained in the car and not paid for.

3. The temperature of shipment will be tested directly as sample is removed from sampling tube, or by immersion of thermometer in the receptacle itself for not less than one minute. A deduction in volume for expansion at temperature of over 60 degrees Fahrenheit will be made at rate of one-twenty-fifth of one per cent for each degree. At 90 degrees the deduction would be one and one-fifth per cent, etc., Kansas and Oklahoma fuel oil furnished from Sugar Creek or Kansas City, Missouri, at 90 degrees, should have a deduction of one and one-fourth per cent.

4. Gravity of fuel oil should range between 13 and 29 degrees Beaume at 60 degrees Fahrenheit.

Conditions.

If any portion of an accepted shipment is subsequently found to be damaged, or otherwise inferior to the original sample, that portion will be returned to the shipper at his expense.

Any sample failing to meet all the requirements of this specification will be condemned, and the shipment represented by it will be returned to the manufacturers, they paying freight both ways.

Unfortunately for us in evolution of the principles of oil burning in locomotives, the matter resolves itself to one of local conditions. The modern locomotive boiler is not an ideal form of oil furnace. Railroads must burn whatever fuel is cheapest and most available, and the matter continues largely to be one of expediency. Locomotive boilers are designed for coal fuel. As above referred to, the application of oil fuel at the start was experimental. How long the oil would last or its market value render its use profitable was an unknown factor. It was formerly our boast that should emergency arise the oil burners could be converted over night in the roundhouse back to coal again. From the figures given us by Mr. Bell it does not seem at all likely that the contingency will soon arise.

Locomotive fuel oil is carried in tanks built to fit the coal space in tender. Additional flat tanks when required are placed over the coal space or back of it. Gravity supply is depended upon through flexible pipes to the locomotive. Each system of locomotive oil tanks on tender is provided with a gauge board or scale from which the fuel records are kept.

The style burner used is the flat jet type consisting of a flat casting divided longitudinally by a partition or table over which the oil flows as it is admitted to the upper cavity or box. The lower cavity receives the steam for the jet which strikes the oil flowing over

[1]Paper presented at San Francisco meeting American Society of Mechanical Engineers' March 10, 1911.

the partition, spraying or injecting it in the furnace. We aim to completely atomize the oil near the burner tip in order that it may be immediately vaporized. I would state here that we have experimented with and tested many kinds of burners in the past, but find that the simple form is the best. The form of burner is of little importance provided it is simple, easy to clean, and without complication from carbonizing. This is especially true of the heavy asphaltic California petroleum. It has in truth been said that those who try to improve the efficiency of oil fuel by alteration of the burner are on a plane with those who try to improve the steaming quality of a boiler by altering the injector. Provided a simple burner is properly set to deliver a thoroughly vaporized spray, each pound of oil will yield its quota of heat units if completely burned. By far the greater efficiency from oil fuel is in the arrangement of the furnace. The steam for atomizing is obtained from the dome and is available at full boiler pressure of 200 lbs. through a suitable regulating valve. We have used compressed air experimentally and for some time used a form of burner that delivered air inductively to the burner itself. Other than a localization of heat at point of the burner, no benefit could be found by tests with air mingled with the steam in this way. Atomization with compressed air is undoubtedly of value under certain conditions, but is liable to produce locally in the furnace a more intense heat than is desirable. With the steam jet the oil is sprayed and broken up so as to allow the air admitted through proper dampers to mix and consume completely without damage to the sheets. Tests on our locomotives by Professor Grey, formerly of the University of California, showed that temperatures ranging from 2500 to 2750 degrees Fahrenheit were obtained, the latter being the highest temperature observed. Firebrick, the most refractory obtainable, are placed at the lower side of the firebox plates to prevent impinging of the oil blast against the sheets. No more brick than necessary for the purpose are used. The most refractory brick melt out in a comparatively short time—not from an intense degree of heat, but from the fluxing agents introduced with the oil, especially salt or other alkalies with which our California petroleums are associated.

(To be continued.)

POLES PURCHASED IN 1909.

The total number of wooden poles purchased by pole consumers in the United States in 1909, according to the Bureau of the Census, was 3,738,740, which is the largest total ever reported. The gain over the number reported for 1908 was 489,586, or 15.1 per cent; and over that for 1907, 455,472, or 13.9 per cent. For the poles purchased in 1909 the sum of $7,073,826 was paid, which, although greater by $1,145,002 than the expenditure reported in 1908, was less by $1,007,942 than that in 1907, when the average cost of poles was greater than in other years. In 1909 the leading kinds of wood were cedar, chestnut, oak and pine, and poles made of these species formed 92.7 per cent of the total number purchased, and represented 95 per cent of the total cost. As in previous years, cedar and chestnut were most important, supplying, respectively, 65.3 per cent and 16.3 per cent of all poles purchased in 1909.

For cedar poles a steady increase is shown, but the number of chestnut poles purchased in 1909, though greater than the number in 1908, was less than that in 1907.

The growing use of oak is notable. In 1907 only 76,450 oak poles were reported, while the number was 160,702 in 1908 and 236,842 in 1909. Other kinds of wood for which steady gains are shown since 1907 are juniper, tamarack, Douglas fir and osage orange. For cypress, on the other hand, annual decreases were reported. More redwood poles were purchased in 1909 than in 1908, but considerably fewer than in 1907.

In 1909, as in previous years, by far the most important consumers were the telephone and telegraph companies, which purchased 2,916,005 poles, or 78 per cent of the total number reported. The electric railroad and electric light and power companies bought 627,414 poles, or 16.8 per cent of all poles purchased in 1909, and the steam railroad companies, 195,321 poles, or a little more than 5 per cent.

Since 1908 there has been an increase of 13.8 per cent in the number of poles purchased by the telephone and telegraph companies and an increase of 18 per cent in the number purchased by the electric railroad and electric light and power companies, while the largest gain, 25.7 per cent, is shown for the steam railroads. In comparison with 1907, however, only the purchases of the telephone and telegraph companies show an increase. The large gain in the returns for these companies is due partly to the omission in 1907 of data for many companies using only short poles.

Cedar and chestnut poles were bought extensively by each class of consumers. The telephone and telegraph companies used a wide variety of woods, reporting relatively large numbers of oak poles, nearly all the poles made of osage orange, and most of those made of tamarack.

The average cost of all poles purchased was $1.89 in 1909, as compared with $1.82 in 1908 and $2.46 in 1907. The somewhat high cost in 1907 is accounted for in part by the lack of complete statistics for that year as to the purchases of short poles, which, of course, have a low average value.

For the telephone and telegraph companies the average cost of poles purchased in 1909 was $1.40 per pole; for steam railroad companies, $2.83; and for the electric railroad and electric light and power companies, $3.89. The variations in these figures indicate in a general way the differences in the size or grade of the average pole suitable for the purposes of the different classes of companies.

Of the total number of poles purchased in 1909, nearly one-third were from 20 to 25 feet in length, and more than one-fourth were from 25 to 30 feet in length. Poles under 30 feet in length constituted nearly three-fourths of all poles purchased, while less than one-fortieth of the total number had a length of 45 feet or over.

Cedar was the leading kind of wood in all lengths of poles purchased. Of the oak poles, more than 92 per cent were under 25 feet in length, and by far the largest part were less than 20 feet in length. Osage-orange poles and other species were also purchased, principally in the short lengths. Many of the oak and

osage-orange poles were used by rural telephone lines or by the so-called "farmers' exchanges."

An increase in average cost since 1908 is shown for each group of poles having a length of 30 feet or over. On the other hand, poles under 20 feet in length cost 56 cents per pole in 1909, as compared with 62 cents in 1908, and poles from 20 to 25 feet in length 82 cents in 1909, as compared with 84 cents in 1908, while for those from 25 to 30 feet in length the average cost was the same in both years.

Of poles having a length of 45 feet or over, Douglas fir poles were purchased for the lowest average cost, while among the shorter lengths the lower-priced woods were tamarack, locust, oak and osage orange. The high average cost of pine poles was due to the fact that large numbers of these were treated poles. Redwood poles had a uniformly high average cost. These were probably mostly sawed, as over 98 per cent of redwood poles were so reported in 1906.

COMPLIMENTARY DINNER TO ELIHU THOMSON.

A complimentary dinner was given by the San Francisco office of the General Electric Company to Professor Elihu Thomson of Lynn, Massachusetts, at the Fairmont Hotel, April 5, 1911. The guests included a number of central station managers and engineers of the vicinity, together with members of the local staff of the General Electric Company. Near its close Dr. Thomas Addison, after extending the company's greeting and welcome to those present, introduced the honored guest of the evening, Professor Elihu Thomson, whose career has been so vitally connected with electrical progress, "much of which he saw, and part of which he was."

Professor Thomson's epigrammatic and inspiring address was concerned with scientific progress and its limitations. Premising his argument on the fact that "all progress is based upon discovery," he traced the work of the early investigators in the last century who found the principles upon which many of our great industries now depend. He stated that "the science of yesterday is the practice of today," and is due not so much to the man as to the age. In this manner, the speaker modestly passed over his own great accomplishments with the explanation that he could not help it.

When this work was first started, telegraphy and electroplating gold and silver were the only industrial applications of electricity, though soon succeeded by the telephone, which "was not so much an electrical discovery as a discovery of the exceeding sensitiveness of the human ear." The electric light was occasionally produced from batteries, but there were no dynamos or motors until the early seventies. There was no consideration of such things as power factor and load factor, nor were there any efficiency engineers. This last profession, by the way, the speaker thought, could be easily overdone, particularly in the extreme case of evaluating the cost per student hour, standardizing students like motors, or in determining the power factor of a church.

Looking upon the application of science from the purely physical side, the speaker sees a vast amount of work yet to be done. The present age, though one of wonderful development, will go down in history as one of fearful waste. The wastes of civilization are so striking and terrible as to require a book for their enumeration; food is sold in packages whose labels cost most than the article they contain; the iron and tin in a can is more valuable than the soup it holds, and many other such inconsistencies are yet to be corrected.

Though electrical machinery has high efficiency, often reaching 98 per cent, its prime movers, the heat engines, are lamentably inefficient. The speaker believes that the gas engine will eventually give the highest possible efficiency, more effectually utilizing the high grade fuel, such as oil, which is now being wasted in locomotive and other boilers. The public must be educated to understand the absurdity of selling oil for two or three cents a gallon and paying many times this price for carbonated and lithiated water, and it is to this end that the technical man of the future must exert his influence.

Thousands of cubic feet of natural gas are wasted in order that a little gasoline may be obtained by compression, whereas the constituent marsh gas might be liquified and shipped in properly insulated containers to even distant markets. Though the cellulose in sawdust can be converted to sugar and thence cheaply fermented to ethal alcohol, government restrictions and red tape bring the price up to fifty cents a gallon, which is prohibitive for power purposes.

The chemistry of the future, so Professor Thomson believes, is to play the most important role in man's advancement. In the electric furnace he will make diamonds for abrasive purposes, from the nitrogen of the atmosphere he will derive the fertilizers for enriching an impoverished soil, and by imitating many plant processes he will supply the needs of man. Particular emphasis was laid upon the possibilities of direct synthesis of ammonia from nitrogen and hydrogen, therefrom to extract the needed nitrates by oxidation.

The limits to which scientific progress may be advanced, this distinguished scientist believes, have been set by Nature in the countless ages during which the present perfection of plant and animal life has been evolved. He asked the question as to what heat engine can reach the 80 per cent efficiency of a man's muscles in converting food to work. He showed how man could also direct Nature forces, hyperbolizing a race of cannibal rats as a means of self-extermination, a selected breed of cattle to eat the spineless cactus and a method of sex segregation to solve the thriftless negro problem.

As examples of Nature's evolution that could well be emulated by man he compared the cold light of the firefly to the heat waste in our electric lights, or the sensitiveness of the human eye to that of a photographic plate, and he further cited the efficiency of the human ear in measuring and recording minute energy manifestations, and the delicacy of the sense of smell as developed in some of the lower animals.

"Civilization originated in curiosity," which has ever spurred the faculty of investigating matters, practical and impractical. In concluding, the speaker briefly summarized recent discoveries in the latter field, the electric theory of matter, the properties of the ether, star formation, and finally the problems as to how life originates in the universe.

Brief speeches were also made by H. H. Sinclair, John A. Britton and C. O. Mailloux of New York City, Mr. Britton in particular delivering a remarkable encomium of Professor Thomson's achievements in the world of science.

The guests present were: C. F. Adams, Dr. Thomas Addison, Wyatt H. Allen, R. H. Alton, R. M. Alvord, F. F. Barbour, Ralph Bennett, T. E. Bibbins, W. T. Bivens, Chas. N. Black, A. J. Bowie, John A. Britton, J. Q. Brown, W. W. S. Butler, W. C. Campbell, Prof. S. B. Charters, C. F. Conn, C. L. Cory, Dr. Cottrell, W. J. Davis Jr., P. M. Downing, Prof. W. F. Durand, C. F. Elwell, Geo. R. Field, S. L. Foster, Arthur H. Halloran, W. W. Hanscom, Geo. J. Henry Jr., Lewis H. Hicks, A. S. Heyward, Geo. C. Holberton, J. Hood, E. A. Hunt, H. F. Jackson, L. R. Jorgensen, S. E. Kearney, G. I. Kinney, W. F. Kelly, Henry A. Lardner, Prof. Joseph N. LeConte, S. J. Lisberger, C. A. Loring, S. G. McMeen, C. O. Mailloux, Geo. R. Murphy, S. L. Napthaly, Prof. C. G. Noble, F. W. Paterson, R. C. Peck, T. W. Ransom, M. Rhine, H. A. Russell, Prof. Harris J. Ryan, H. E. Shedd, W. M. Shepard, E. O. Shreve, H. H. Sinclair, H. C. Stanley, Frank Stone, A. Strauch, Prof. Elihu Thomson, A. V. Thompson, F. T. Vanatta, R. W. Van Norden, F. H. Varney, F. E. Vickers, W. G. Vincent, J. E. Woodbridge.

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Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September 1895.
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CONTENTS

Steam Turbine Auxiliaries

When the long distance transmission of power from hydroelectric plants was successfully established many small steam-driven isolated plants were eliminated, as their operators could not compete with such cheap power and were glad to go out of business in a dignified manner while the opportunity offered. Many industries which formerly relied upon a prime mover thus became dependent upon a transmission system whose weak points as regards continuity of service soon showed that a steam-driven auxiliary was occasionally necessary at the point of maximum distribution. When idle, this necessary investment added a financial burden so great as to seriously impair the low power cost advantages of the transmission system, and it was not until the advent of the steam turbine that the hydroelectric plant was relieved of this financial load.

The steam turbine has a large overload capacity and can be operated in synchronism with the transmission line when not supplying power. While thus "floating" on the line it takes only enough power to overcome mechanical friction and windage and requires little attention. Generally speaking, power from the steam turbine plant cannot be sold as cheaply as from a transmission system. To get the highest commercial efficiency, pre-supposing a regular water flow, a transmission system must operate with unity load factor; this is manifestly impossible without a diversified distributing system, in fact, the load factor might be so low as to make the power cost higher than that from an auxiliary steam plant, which then becomes a desirable investment. By making the steam plant's capacity greater than the requirement for handling all of the load peaks, the transmission system is given the higher load factor essential to economy. Furthermore the auxiliary plant is ready in emergency to take over a large part of the load. The combined plant can thus be rated at a greater capacity than that of the original hydraulic installation and a part of the gross earnings may be credited to the auxiliary plant.

In large cities there is always an opportunity to supply power at a low load factor. As the isolated steam turbine plant is able to compete, in a small way at least, with the transmitted supply, the field of the small plant is again opened and the rapidly growing additions of not only central station plants but isolated plants in industrial and public buildings is again noticeable. The growth of the application and use of power is far greater than is generally thought and the transmission systems are loading with that class of business which offers steady loads. Beyond this some means must be provided for taking much business which they do not reach and this is the sphere of the new era of steam driven stations.

PERSONALS.

C. R. Collins, of the Seattle Electric Company, is at San Francisco.

Robert Sibley, consulting engineer, Missoula, Mont., was at San Francisco this week.

Thomas Mirk, of the engineering firm of Hunt, Mirk & Co., is at San Diego on business.

George B. Murch, an electrical supply man of Los Angeles, was a recent San Francisco visitor.

J. H. Harisberger, superintendent of the Seattle-Tacoma Power Company, spent the past week at San Francisco.

C. C. Lapham, of Los Angeles, who is interested in wireless telegraphy and telephony, is a San Francisco visitor.

Van E. Britton, gas engineer, is supervising the high pressure gas installation at Willows and Red Bluff, California.

W. G. Kerckhoff, president of the San Joaquin Light & Power Corporation, has returned to Los Angeles from New York City.

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation of Fresno, was a San Francisco visitor during the past week.

F. G. Baum, of F. G. Baum & Co., electrical engineers, left last Tuesday on a business trip to New York, which will occupy several weeks.

Robert M. Frick, of San Francisco, has been elected vice-president of the Bay Cities Home Telephone Company, as successor to S. G. McMeen, resigned.

S. F. B. Morse, Jr., a son of Professor S. F. B. Morse, the inventor of telegraphy, was at San Francisco last Monday from Merced, where he has mining interests.

J. P. Bradner has resigned as sales engineer with Pierson, Roeding & Co. of San Francisco and will look after his private interests for a time before deciding upon future affiliation.

Leon M. Hall, electrical engineer, left for the San Joaquin Valley last Wednesday on business connected with the construction of an impounding dam on Quintos Creek, for a large irrigation project.

John Coffee Hayes, general manager of the Mt. Whitney Power Company of Visalia, and also connected with the management of the La Grange Power Company, has returned from a business trip to New York.

P. M. Hansen, managing director of the Auckland Electric Transit Company of Auckland, New Zealand, passed through San Francisco last week en route to London to attend the coronation of King George.

A. B. Cass, president of the Bay Cities Home Telephone Company, and also of the Los Angeles Home Telephone & Telegraph Company, spent the past fortnight at the San Francisco office of the former corporation.

J. B. Lukes, who has charge of the Stone & Webster Company's work at Reno, Nev., has been spending a few days at San Francisco. His company handle the Sierra Nevada Power Company's system for the W. P. Hammon interests.

TRADE NOTES.

The Grays Harbor Railway, Light & Power Company, of Aberdeen, Wash., has purchased from the General Electric Company, through the Seattle office, a 1000 kw. Curtis turbo-generator set as auxiliary equipment. It will be installed in the Anderson-Middleton Lumber Company's plant at Aberdeen. This company will furnish the necessary steam for the turbine.

LOS ANGELES SECTION A. I. E. E.

The regular meeting of the Los Angeles section of the American Institute of Electrical Engineers was held at Blanchard Hall, March 28, 1911, with an attendance of 96 members and visitors. Mr. A. H. Babcock gave a discussion from the standpoint of the Southern Pacific Company on the specifications for overhead crossings of electric light and power lines. The specifications were also touched upon by some of the other speakers. The meeting was honored by the presence of two past presidents, Prof. Elihu Thomson and Mr. Bion J. Arnold, both of whom addressed the meeting. Addresses were also made by O. H. Ensign and J. A. Lightipe and by the following visiting engineers: Prof. W. F. Durand, G. L. Hoxie of New York, Kempster B. Miller and S. G. McMeen of Chicago, and Prof. C. L. Cory.

The 1911 Pacific Coast Convention was discussed and regret was expressed that some of the distinguished visitors would not be able to be with us at that time. A letter from President Jackson with reference to the constitutional amendment was read and discussed. The meeting then adjourned.

Previous to the meeting the local executive committee entertained at dinner at the University Club the speakers mentioned, as well as Theo. B. Comstock, engineer Los Angeles Board of Public Utilities; W. G. Vincent of San Francisco, Geo. A. Damon of Chicago, R. J. Cash, Los Angeles manager General Electric Company; M. M. Corbin and G. H. Hill of the General Electric Company, Schenectady, New York; E. F. Scattergood, electrical engineer of the Los Angeles Aqueduct; Horatio A. Foster, associated with Mr. Arnold; S. H. Anderson, electrical engineer Pacific Electric Railway, and C. G. Watson, superintendent Ontario & San Antonio Heights Railway.

The local executive committee consists of J. E. MacDonald, chairman; secretary of Joint Pole Committee; E. R. Davis, electrical engineer Pacific Light & Power Company; I. T. Dyer, superintendent telegraph, Salt Lake Road; J. A. Lighthipe, electrical engineer Southern California Edison Company; R. H. Manahan, city electrician; E. R. Northmore, superintendent Los Angeles Gas & Electric Corporation, and V. L. Benedict, manager Los Angeles Fire Alarm Company.

After the meeting A. L. Havens, the Los Angeles manager of Pierson, Roeding & Co., entertained the visitors at the Jonathon Club.

NEW CATALOGUES.

The Duplex Metals Co. of Chester, Pa., in "The Copper Clad Handbook," give valuable facts and figures about the manufacture and characteristics of Copper Clad wire.

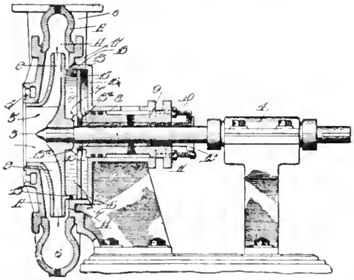
Electrical Engineers Equipment Co. of Chicago, Ill., has issued a catalogue of electrical fittings for power plants manufactured by them. Much interesting tabular data is included in the booklet.

In Bulletin No. 4815, recently issued by the General Electric Company, are illustrated and described continuous and alternating current motors, and apparatus for controlling them when applied to machine tool operation. The publication contains also illustrations of the motors installed on drills, saws, shapers, milling machines, slotters, planers, lathes, etc.

One of the recently issued publications of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., is Circular No. 1191, covering multiple and multiple series metallic flame arc lamps, which are used for lighting places where direct current is available and where high intensity illuminating units are required, such as business streets, parks, freight yards, mills, car-barns, foundries, machine shops train sheds, etc.

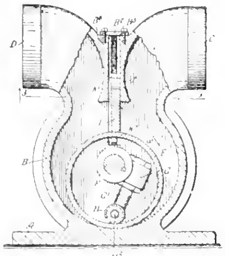
PATENTS

987,976. Turbine-Pump. Walter L. Forward, West Berkeley, Cal., assignor to Byron Jackson Iron Works, Berkeley, Cal. An automatic balancing means for a turbine pump, such means comprising a casing having inlet and discharge passages, a runner or impeller mounted upon a shaft and revoluble within the casing, said impeller and casing form-



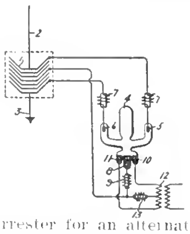
ing chambers within which liquid pressure may accumulate, and said impeller having ports near its circumference and axis forming communication between said chambers and means whereby the ports are automatically controlled by the endwise movement of the runner.

987,711. Rotary Pump. Adelbert Fournier, Sprague, Wash., assignor to James F. O'Brien, Seattle, Wash. A rotary pump, comprising a cylinder having an inlet and an outlet, a ring-shaped piston mounted in the cylinder to roll on the inner surface of the cylinder, an abutment mounted to slide in the said cylinder and connected with the



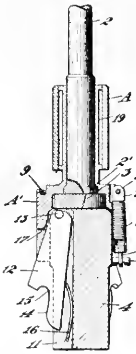
said piston to move in unison with the latter, a driving shaft extending eccentrically through the said piston and axially through the said cylinder, arms on the said driving shaft, rollers in contact with the inner surface of the said piston, and adjustable connections between the rollers and the said arms.

987,924. Rectifying System for Aluminum Cell Lightning-Arresters. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. The combination with an elec-



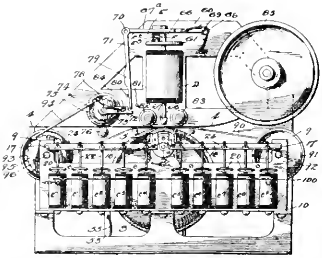
trolytic lightning arrester for an alternating current system, of a mercury arc rectifier connected to derive a unidirectional potential from said system and to impress it on said arrester.

988,054. Beading-Tool for Builer-Tubes. Eugene Witt, San Francisco, Cal. A multiple beading tool, comprising a tool holder and a suitable support therefor, means holding the tool holder to the support while allowing it to yield



longitudinally thereof, a series of radially movable beaders mounted in said yieldable holder, and means for imparting a series of blows through the tool holder simultaneously to all the said beaders.

988,218. Electrical Signal-Recording System. Alfred L. Sohm, Whittier, Cal., assignor to Sohm Electric Signal & Recording Company, Los Angeles, Cal. A device of the character described, comprising a plurality of numbered signal sending means, means to record any selected digit from 0 to 9 in the units place on a suitable receiving medium, means to record any selected one of a series of digits in the tens place on said receiving medium, a series of coils corresponding in number to the units digits and adapted upon being energized to select the digit to be recorded in the units place by the first named recording means, a series of coils corresponding in number to the tens digits and adapted upon being energized, to select the digit to be recorded in the tens place



by the second named recording means, each of said units digit-selecting coils being in electrical communication with all signal sending means whose unit digit corresponds to the units digit, the selection of which is controlled thereby, and each of said tens digit-selecting coils being in electrical communication with all signal sending means whose tens digit corresponds to the tens digit, the selection of which is controlled thereby, electrically actuated means to produce forcible contact between said recording means and said receiving medium, said contact means being adapted to be energized by a local battery circuit and means to automatically close said local battery circuit through said contacting means when said recording means is in operative position, substantially as described.

INDUSTRIAL

AN ELECTRICALLY OPERATED GAS METER.

A useful laboratory method for measuring the passage of a quantity of gas of any kind is to insert an electric heating coil in the pipe, measuring the temperatures of the stream of gas before and after passing the heater. Knowing the specific heat of the gas—that is, the heat necessary to raise 1 cu. ft. of it 1 deg. in temperature—and having measured the electrical energy converted into heat by the coil, the volume of gas passed can easily be computed. Again, if with the same arrangement we vary the current flowing in the heater so that the difference in temperature shown by the thermometers remains constant, the electrical energy taken by the heater and measured by a watt-hour meter will be exactly proportional to the gas which has passed.

A practical meter designed for measuring the flow in large gas mains which accomplishes automatically the regulation of the heating current to keep the temperature difference of the two thermometers constant at 2 deg. Fahr. is the invention of Prof. C. G. Thomas, of the University of Wisconsin. The stationary measuring element, Fig. 1, which is inserted in the main pipe carrying the gas or air to be measured contains an electrical heating coil B, and on each side of the heater are two screens of fine resistance wire EE having the function of thermometers, arranged as the arms of a Wheatstone bridge. Variations in the temperature difference between these two screens cause deflections in a galvanometer needle, making contacts to close magnetic clutches and by means of a motor-driven ratchet wheel and rheostat increasing or diminishing the energy flowing into the heater. The recording watt-hour meter which measures this energy input into the heater is calibrated to read directly in cubic feet of gas. The electrical energy to operate the meter is approximately 1 kw. per 75,000 cu. ft. of illuminating gas, with the screens set for 2 deg. Fahr. difference in temperature. This figure varies, of course, for different gases measured.

The principle of the meter thus enables it to measure gas or air at any temperature and at any pressure, its accuracy not being affected by fluctuations of either, since in heating gas or air the temperature rise depends upon the mass of the gas, not its volume. Whether 1 lb. of air occupies 10 cu. ft. or is expanded to 100 cu. ft. the amount of electrical energy taken to raise its temperature 2 deg. is identical, and whether the gas is moving rapidly or slowly through the meter exactly the same amount of energy will be required. If the gas enters the meter at 60 deg. its temperature will be raised to 62 deg. If it enters at 100 deg. Fahr. its temperature will be raised to 102 deg., so that, as stated above, neither temperature nor pressure has any effect on the accuracy of the meter's measurements.

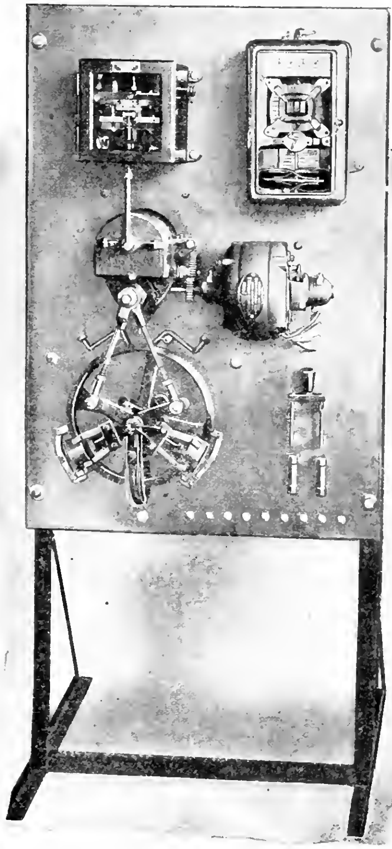


Fig. 2. Switchboard and Recording Mechanism of Thomas Electric Gas Meter.

The important features of the meter are: There are no moving parts inside the gas main. This meter measures weight or mass of gas instead of volume as do other meters,

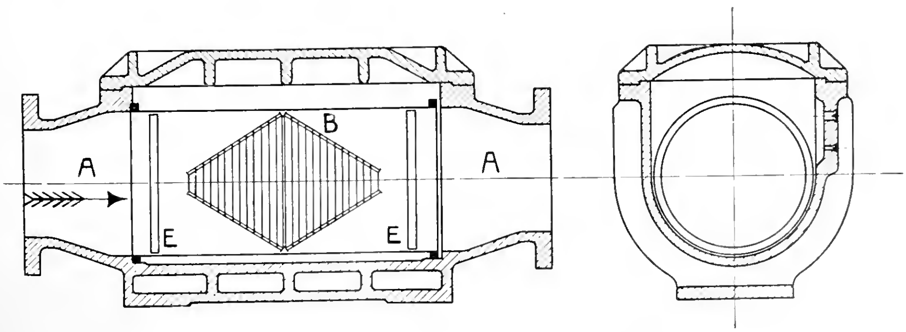


Fig. 1. Heater and Thermometer Element of Thomas Gas Meter.

and will read directly in standard cubic feet regardless of temperature or pressure, its operation being independent of temperature or pressure and of fluctuations in either. Meters of very large capacity occupy but little space, and since the parts are connected electrically they can be located at any distance from each other. The recording mechanism, for instance, may be placed in the general offices of a gas company, which may be a mile or more from the gas works.

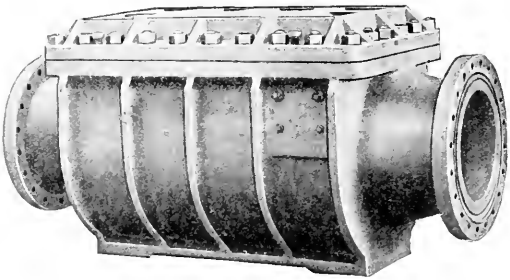


Fig. 3. Thomas Gas Meter.

The principal applications of the Thomas meter are measuring illuminating gas, natural gas, blast-furnace gas, compressed air, air flow in ventilating or forced-draft systems, etc. Since in the operation of the meter about 1 kw.-hour is consumed for the passage of each 75,000 cu. ft. of gas the device becomes a desirable load for the central station company to have on its lines. The consumption is largely long-hour business, while, due to the superior inherent characteristics of this meter, it is applicable to a large number of other uses besides the eminently satisfactory one of making a central station customer of the competing gas company.

The Thomas meter is manufactured by the Cutler-Hammer Company, Milwaukee.

PORTABLE TELEPHONE SETS.

With the spread of telephone train dispatching among the railroads in this country, a piece of apparatus has come into extensive use on such lines, and every day sees its adoption to a greater extent. This is the portable telephone set.

This set is being used by officials in their private cars, inspectors who have to cover the line, train crews and construction, bridge and wrecking gangs.

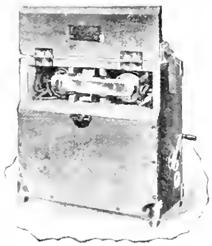


Fig. 1. No. 1330—Set equipped with powerful 5-bar generator.

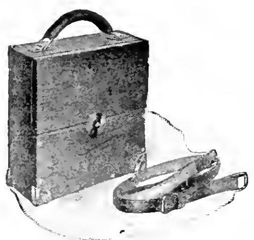


Fig. 2. No. 1331—Set with leather case, closed.

The advantages of the portable telephone set are striking. Communication can be established immediately between a distant point and headquarters by means of such a set carried on trains, and connected to the telephone train wires by means of a line pole. In cases of emergency, this one feature has more than paid for the total cost of the installation of the telephone circuit. Delays to traffic are reckoned in dollars and cents, and on important lines, such delays are tremendously expensive. With a telephone at hand, and the conductor or someone else able to give headquarters detailed advice in regard to conditions on the spot, hours are frequently saved.

Three of the sets in general use among the railroads are those manufactured by the Western Electric Company and known as the Nos. 1330, 1331 and 1332 types. The first named is declared by the manufacturers to be the most efficient set on the market today. It is equipped with a powerful 5-bar generator and finished with a special weatherproofed varnish. The construction is of the strongest throughout, and the corners are reinforced with steel. The hand set in this particular case is attached to a 6-foot cord so that the user may stand upright when the set is on the ground, and a push-button is provided in this hand set so that the transmitter circuit is closed only when desired.

Fig. 3. No. 1332—A small and light talking set, in leather case.

The No. 1331 set is of similar design, but equipped with a 3-bar generator. The No. 1332 set is for use on train wires where the dispatcher is at all times connected with the circuit, and it has no generator.

Many of the roads are equipping every train on their line with these sets, and their use on wreckers is very general. In some cases, the portable telephone set is made part of the standard equipment of the engine.

On the Seaboard Air Line some of the conductors recently petitioned to be allowed to purchase these sets for their own use, out of their own pockets, so greatly did they appreciate the advantages of such apparatus in times of emergency.

LARGE WESTINGHOUSE MOTOR ORDER.

The Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., has recently received an order from the Kern River Oilfields of California, Ltd., calling for the largest number of oil well motors ever placed in this territory at one time. The order is for early delivery and calls for one hundred motors, which will be used in the Kern River field for pumping and cleaning the great number of oil wells on the properties of the above company. The motor adopted is of the back-geared type and a pulley on the countershaft drives the main belt. The motors are of the alternating current, varying speed, continuous service, induction type and will operate on a three-phase, 60 cycle, 440 volt circuit. The motor windings are so arranged that by the simple operation of the switch handles two economical working capacities are obtained. The motors will operate continuously at 10 h.p. output with high efficiency on pumping service; for cleaning wells, they will easily develop 30 h.p. on intermittent service. For oil well service, this double feature makes this type of motor especially suitable. The results obtained in the way of economy of operation, both as to consumption of power and to cost of maintenance and attendance, as compared with gas and steam operation, will prove of great interest to operators in the oil fields.

NEWS NOTES

INCORPORATIONS.

REDLANDS, CAL.—The Coachella Valley Ice & Electric Company has been incorporated by W. F. Holt, Chole Holt and W. G. Driver, with a capital stock of $300,000.

OAKLAND, CAL.—The American Heat & Power Company has been incorporated by J. H. King, J. A. Craig and J. H. Becker, with a capital stock of $100,000.

SAN FRANCISCO, CAL.—The Oakland, Antioch & Eastern Railway Company has been incorporated by A. W. Maltby, L. Arnstein, J. R. Selby and A. J. Kantmeyer, with a capital stock of $80,000.

SPOKANE, WASH.—The Mountain Lake Power & Irrigation Company has been incorporated by T. Z. and L. T. Gillett and C. T. Camplan. The company will take over the Carp Lake project, in Goldendale, and irrigate 10,000 acres.

SALEM, ORE.—The Kingwood Park Light & Water Company has been incorporated by Geo. P. Dekum, Rollun K. Page and Chas. A. Robertson The new company will construct transmission lines across the river at Kingwood Park and power will be procured from the Portland Railway, Light & Power Company

TRANSMISSION.

ELGIN, ORE.—E. W. Rumble has presented to the council an ordinance for a franchise for 50 years, to allow running a power line in the city. The power is to be harnessed in the Wallowa river.

SAN BERNARDINO, CAL.—The Union Power Company, preparing to develop power in Bear Creek canyon, has filed claim to 3000 inches of water in Bear Creek. The appropriation is made under the name of D. R. Paramore, who states that power is to be developed for the use of San Bernardino, Riverside, Orange and Los Angeles counties.

NEWPORT, ORE.—The franchise and plant of the Newport Power Company has been sold to Henry Hewitt, J. J. Hewitt and Seymour H. Bell, Tacoma and Portland capitalists. The new owners will spend $30,000 on the reconstruction and re-equipment of the plant. New buildings and new wiring system throughout the city are the changes proposed. The new company will be known as the Yaquina Electric Company.

SAN FRANCISCO, CAL.—At a meeting of the finance committee of the supervisors last week the site for the proposed power house for the Geary street municipal railroad was announced. The committee declared in favor of locating the plant on two 50-vara lots on the west side of Jones, between Beach and Jefferson streets. One of the lots is owned by E. A. Norton and is held at $30,000, and the other, which is owned by Mary's Help Hospital, is held at $35,000. Options have been obtained on the property, and the committee requested the city and county attorney to look into the titles of the same.

ILLUMINATION

SPOKANE, WASH.—Spokane Falls Gaslight Co. will add 8 new benches and erect a retort building at a total cost of $100,000, this summer.

GRANTS PASS, ORE.—A. W. Butler of the Grants Pass Gas Company, says plans are now being drawn for necessary buildings and portion of the machinery ordered for the gas plant.

EAGLE ROCK, CAL.—A franchise for building an electric lighting system in Eagle Rock district has been sold to the Eagle Rock Water Company.

ROSEBURG, ORE.—W. F. Boardman of San Francisco and Thos. D. Petch of Medford, Ore., will apply for a franchise to operate a gas plant here.

LODI, CAL.—The Western State Gas & Electric Company has purchased a lot on Cherokee lane, just south of Railroad avenue, for the site of a new sub-station and transformer house.

WINONA, WASH.—M. W. Fockler of this place states that he has purchased 8½ acres one mile west of this place and will erect a power house for supplying light to Endicotte, Lacrosse and this place.

SPOKANE, WASH. The Spokane Gas Company is contemplating increasing the capacity of its gas plant, located on the Northern Pacific tracks at Scott street. The improvements contemplated will mean the expenditure of $100,000.

ASHLAND, ORE.—H. G. Butterfield, foreman of the construction for the completion of the municipal electric light and power plant, made the estimates of cost of completion for street lighting and house lighting service system for the city at $17,657.

PETALUMA, CAL.—Manager H. H. Weber of the Pacific Gas & Electric Company, has received word from the San Francisco office that the contract for the erection of the gas-holder on the corner of First and C streets, had been awarded to an Eastern firm.

SAN FRANCISCO, CAL.—The Manila Electric Railroad & Lighting Corporation directors have declared a quarterly dividend of 1½ per cent on the $5,000,000 stock, payable April 1 to shareholders of record March 20, thus increasing the annual rate from 4 per cent to 5 per cent.

MACDOEL, CAL.—The California Butte Valley Land Company has contracted with the Siskiyou Lighting Company to bring electricity into the town of Macdoel for lighting and power purposes, including the furnishing of 8000 h.p. to farmers for pumping. The power is to be ready for use by July 1.

BRAWLEY, CAL.—The City Council has been asked to sign a contract for the city which provides for furnishing electricity for a period of two years at a minimum rate of $40 a month for 40 h.p. Motor Superintendent McCormick of the Holton Power Company, states that the company will furnish poles and transformers. The rate is 5 cents a kilowatt.

SEATTLE, WASH.—The Seattle Electric Company has declared an extra dividend of 2 per cent on the common stock along with the regular 1¾ per cent quarterly distribution (the rate paid since October, 1909), both payable April 15, to holders of record March 13. The usual 3 per cent (semi-annual) payment on the $5,000,000 preferred stock will be made April 1 to holders of record March 13.

SAN FRANCISCO, CAL.—U. S. District Judge Van Fleet has modified the restraining orders heretofore granted in what are known as the gas rate cases, in which the Metropolitan Light & Power Company attacked the rate fixed by the Supervisors for the past two years as confiscatory of the company's property. The order is modified so as to require the company to put all moneys received in excess of the rates fixed by the Supervisors into the Mercantile National

Bank of San Francisco, to be held by the bank subject to the future orders of the Court.

MODESTO, CAL.—To supply Turlock, Denair, Ceres and farm homes on the route between Modesto and these places, with gas from its Modesto plant is the plan of the Modesto Gas Company. The plans as thus far perfected contemplate a 2½ inch gas main connecting the cities named with the enlarged gas manufacturing plant of the company on Ninth street in the southern part of town. It is thought that this will deliver sufficient gas to supply the demand for the immediate future, and the company plans to enlarge the connecting main as more gas is needed.

BAKERSFIELD, CAL.—Eight gas compressors have been shipped from Pennsylvania by the Bessemer Gas Engine Company to be used in extracting gasoline from the gas wells of the Honolulu Consolidated Oil Company in the Buena Vista hills. On their arrival work will begin on the plant, which will be the first attempt on a large scale to utilize the Buena Vista natural gas for this purpose. It is stated that the Bessemer company, which has established a permanent office here in charge of W. D. Shira, has made propositions to companies owning gushers in the West Side fields to erect plants and extract gasoline on a royalty basis from the gas now going to waste from these flowing wells.

TRANSPORTATION.

PORTLAND, ORE.—The Council has granted to the Mt. Hood Railway & Power Company a 25-year franchise to operate an electric light and power system in this city.

SAN JOSE, CAL.—The San Jose Railroads Company has asked for an opportunity to bid for a franchise on North Fifth street, between St. John and St. James streets, and on St. James street, between Fifth and Sixth streets.

WILLOWS, CAL.—Two hundred prominent residents and business men of Redding, Red Bluff, Corning, Williams, Woodland and Willows, have held a meeting to organize a company to build and maintain an electric railroad from Woodland to Redding.

FRESNO, CAL.—The Hanford & Summit Lake Railroad Company will extend its line from Hardwick, in Kings County, to Jamison, 26 miles west of this city. The line will be 36 miles in length, and, with the exception of four miles, will be located in Fresno County.

OAKLAND, CAL.—Damages in the sum of $331,200 is demanded of the San Francisco, Oakland and San Jose Consolidated Railway (Key Route) by Henry Dalton & Sons' Company because of the alleged unlawful cutting off of the plaintiff concern from deep water by a bulkhead constructed by the railway corporation.

SPOKANE, WASH.—The Panhandle Electric Railway Company, headed by Victor M. Smith of New York, will expend $2,000,000 in the construction of a plant at Priest River, Idaho, capable of developing 30,000 h.p. It is announced the company will also build a transmission line from Priest Rapids to Spokane.

SEATTLE, WASH.—A new interurban electric line is proposed to be constructed between Seattle and Lake Burien, four miles south of the city limits, according to the petition for a franchise presented to the Board of Commissioners by Geo. W. H. Write. The board has set the date for hearing on the petition at 2 p. m., April 18.

LAKEPORT, CAL.—A mass meeting last week started a public movement to build a railroad from Hopland to Lakeport. W. J. Thomas, superintendent of the Mill Valley and Mount Tamalpais railroad, spoke at length on the possibilities of such a road. The president of the businessmen's association, of Lakeport, appointed a committee of five to confer with the officials of the Northwestern Pacific Railroad. It is proposed to finance the road entirely by private stock subscriptions from citizens of Lake County and Hopland.

SAN FRANCISCO, CAL.—For the purpose of hauling its freight trains between Sacramento and Chico, the Northern Electric Company has turned out what is probably the largest electric locomotive in the world. It is mounted on a car 57 feet long, and has two motors aggregating 600 h.p. The designer is J. P. Edwards, head of the company's electrical department.

REDONDO BEACH, CAL.—It has been ordered that a third rail be laid along the Los Angeles and Redondo railway right of way over a portion of Pacific avenue and Diamond street. The order calls for immediate compliance. It is understood that when the work is completed passenger cars over the Los Angeles-Pacific system will be transferred from the Sherman barns to this point.

OAKLAND, CAL.—Work has begun upon the roadbed for the new electric line of the Southern Pacific to San Leandro, which is an extension of the Seventh streets local line from Melrose, the present terminus. A large force of men have commenced operations in Dutton avenue and are working toward the northwest to meet the line from Melrose. From Melrose the line passes through Melrose Heights and Seminary Park districts, after which it closely parallels the Foothill boulevard to Broadmoor. A private right of way through this tract has been secured and from the junction of this right of way with Dutton avenue the railroad will extend to and span San Leandro Creek, and continue along Santa Clara avenue, to Estudillo avenue, where the new terminus is to be located. If the trustees of San Leandro will secure a right of way for the company's double tracks from Dutton avenue the railroad will construct a concrete bridge across San Leandro Creek. This would provide a new road between the annexed districts and eastern San Leandro, and relieve the congestion along Hayward avenue.

OAKLAND, CAL.—At last week's meeting of the City Council, Attorney Chapman stated that the Oakland Traction Company would apply for no more franchises after the new charter goes into effect on July 1. The reason, he said, is that the company cannot afford to pay the city the 5 per cent on the gross earnings as demanded by the charter, and at the same time pay 6 per cent on foreign money borrowed for building lines. Among the traction company applications was one on East Sixteenth street, recommended for passage. On another, Market street, from San Pablo to Fifty-fifth street, no action was taken. In the application for a franchise on Thirteenth street from Washington to Market, the application was withdrawn with the consent of the Council, and Chapman announced that he would offer as a substitute an application on Thirteenth street from Washington to Market, and south on Market street to First. As a solution of the congestion in Broadway, caused by the switchback between Seventh and Eighth streets, the company asked for a franchise in a loop around the block bounded by Broadway, Franklin, Eighth and Ninth streets.

TELEPHONE AND TELEGRAPH.

AUBURN, CAL.—J. B. McCleary has applied for a telephone franchise in this city.

WILLIAMS, CAL.—Amiel M. Harris has purchased the telephone line in this city and plans enlarging the system.

SUSANVILLE, CAL.—The California & Oregon Telegraph Company has applied for a 50-year telephone system in this town.

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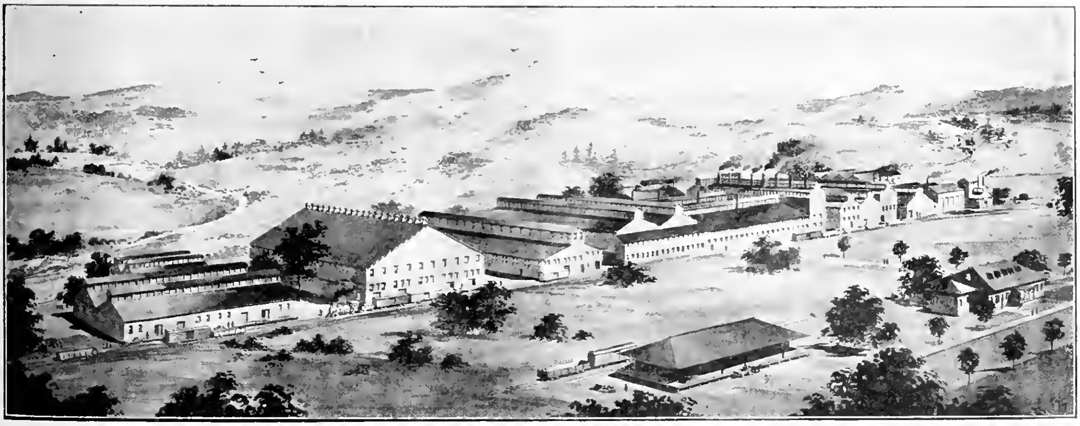
MOTOR DRIVE IN COWELL CEMENT PLANT

BY RUDOLPH W. VAN NORDEN

The plant of the Cowell Lime & Cement Co. is situated about three miles from the town of Concord, California, and is served by the company's railroad from Bay Point on the main line of the Southern Pacific and the Santa Fe railroads. Cheap power and fuel, together with large deposits of raw material near tide-water, have made the development and operation of this industry of the greatest commercial importance to the Pacific Coast.

The manufacture of Portland cement requires a limestone high in calcium and low in magnesia, iron oxides and other impurities. There is also required silica and alumina which are found in certain clays and shales. These raw materials, one a rock and the other a finely divided plastic material, are thoroughly dried and then reduced to a coarse powder, when they are mixed in certain proportions. This operation is perhaps the most delicate throughout the process and requires the constant attention of the chemist. The mixture is then pulverized to an impalpable powder. The next process is calcining in which the powder is fed through rotating furnaces or kilns where it is heated to the point of incipient vitrification. The resulting clinker is first cooled and piled into storage bins, where by standing it undergoes a chemical change necessary to the permanence and quality of the product. The clinker to be of use as cement must be ground to powder.



Plant of the Cowell Lime and Cement Company.

From the viewpoint of the electric power company, the cement plant presents an almost ideal load and for this reason it is possible to quote lower relative rates for a business of this kind than for other loads having a lower load-factor. To operate economically, the cement plant must work twenty-four hours per day and as practically every operation is continuous the total load is unusually steady.

All of the cement plants in California, and there are at least eight of importance, receive their power over long distance transmission lines from hydraulic generating plants, and this power is used for every purpose and in every operation of cement making, except that of heating.

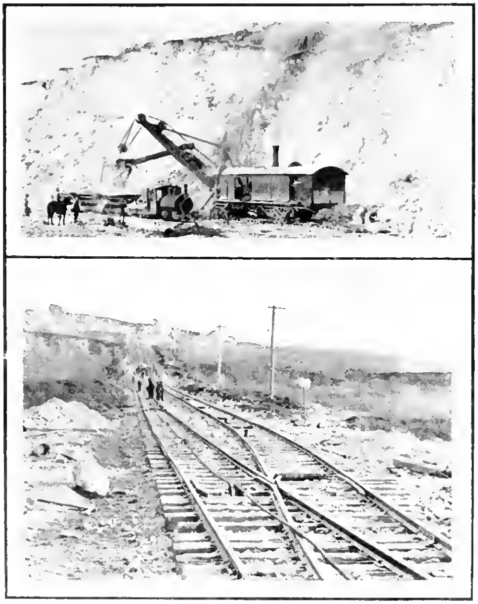
The second grinding process is similar to the first, the clinker being first ground to coarse grains and then to an impalpable powder. Before reaching the grinders it is mixed with a predetermined proportion of gypsum, but unlike the first grinding, there is no mixing neces-

sary between the coarse and fine grinding. The fine powder obtained is the finished product, Portland cement, and is placed in storage or shipped as required.

The method as thus briefly outlined, though apparently simple, is the result of practice and experience extending over many years, and requires expensive and highly developed machinery and apparatus, takes a large amount of fuel and power and calls for the most constant attention and skill in management and operation.

Quarries and Raw Materials.

The plant lies on a practically level tract at the foot of a gently sloping hill containing the limestone and clay quarries, the former at some elevation above the latter which is close to the plant. There are several limestone quarries or rather there have been several faces opened, the highest being at present in use. The two lower faces are reached with easy grade by a continuation of the company's railroad. The main quarry is connected by an incline as it is so high as to make the extension of the main railroad to the quarry inadvisable.



Steam Shovel Working in Main Quarry.
Incline From Quarry to Crusher House

In the main quarry, the limestone face is first drilled with air drills and the material blasted out. A 5-yd steam shovel loads the rock on to a train of side-dump cars. The track here is 42 in. gauge and extends to the various parts of the quarry and to the top of the incline. Up to this point the cars are shunted and moved by a small locomotive. There are three of these trains in constant use, one loading while the other is delivering its load to the incline, and the third dumping into the crushers.

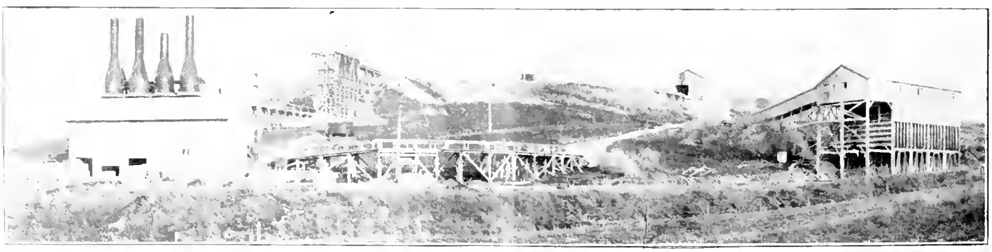
The incline extends a distance of 1700 ft. to and within the crusher house. There are two tracks and between the rails of each is operated a 1¼ in. steel cable. Either end of this cable is permanently fastened to a steel car and at the top of the incline it passes over pulleys and around a drum equipped with manually operated brakes to control the movement of the cars. A loaded train of dump cars coupled to a cable-car pulls up a train of empties while it descends to the crusher house.

The crusher house is a substantial steel-frame building, covered with corrugated iron. At one side of the track which runs through the building, is a bin into which the cars dump. This bin delivers the rock into a No. 9 Gates gyratory crusher, placed on a lower level than that of the track, which reduces it to 4 in. diameter or smaller. Rock from this crusher is delivered into a revolving screen having 2 in. mesh. All of the rock which is larger than 2 in., and which therefore will not pass through the screen is picked up by an endless belt elevator and delivered into another set of bins. These bins discharge into two No. 6 crushers of the same type as the first. From these the rock emerges at a size of 2 in. or smaller and is delivered on to an endless belt conveyor, to be taken to the bunkers.

Induction motors furnish the power to drive the crushers as well as to dump the cars. The No. 9 crusher is belt driven by a 150 h.p. motor, while the No. 6 crushers are each driven by a 75 h.p. motor. The dumping device consists of a reel driven by one of the motors, on which a wire rope is wound while dumping. This rope passes up over a pulley and is hooked to one side of a car, raising that side and lowering the other, thereby tipping the car-body partly over and emptying its contents.

The conveyor to the bunkers passes through a long covered passageway and discharges into another conveyor which discharges the rock through a movable dumping device, into any one of the bins at the will of the operator. These conveyors are operated by a 30 h.p. induction motor.

The ten storage bins or bunkers are arranged in



Crusher House, Bins and Lime Kiln.

two rows, and have a total capacity of about 800 tons. Under them are two tracks connecting with the main track and leading to the plant.

From the crusher house rock may be also taken in carts to supply a lime kiln. This is a separate industry and will not be described here.

Between the lime kiln and the plant is the clay deposit. This is operated by a steam shovel, which fills the cars delivering the material directly to the plant.

From the quarry an average of 1200 tons of limestone is taken daily. The chemical composition of both the limestone and clay is not constant within certain limits, but a fair analysis is as follows:

	Limestone.	Clay.
SiO_2	1.36	59.80
Fe_2O_3	0.24	6.74
Al_2O_3	1.48	20.28
MgO	0.35	0.77
$CaCO_3$	96.95	....
CaO	....	1.69
Loss on ignition	....	10.88

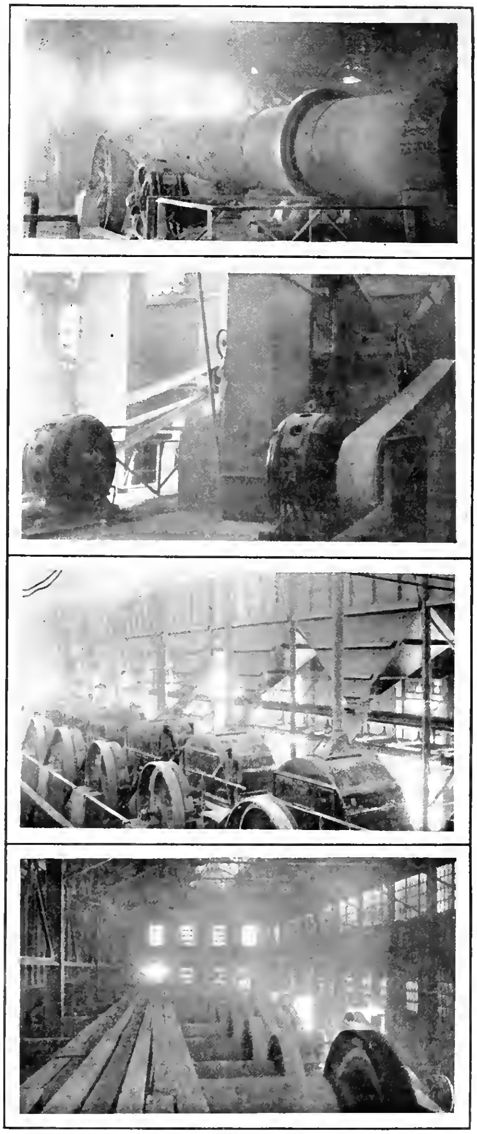
Plant.

All of the buildings are structural steel frames of ample design. The sides and roofs are covered with No. 24 galvanized corrugated iron, fastened to channel purlin sills and studding with patent nail-head wire fasteners. Ample provision is made for windows and monitor roofs and a liberal use is made of ventilators to care for the clouds of impalpable dust from the tube mills.

The crushed stone and clay are delivered in standard side-dump cars to their respective bins, under the tracks, the storage capacity being 20,000 tons of stone and 800 tons of clay. In the crushed rock section there are four tracks which run through the building, being supported on steel super-structure. Under each track are three concrete bins of rectangular cross-section and bottom sloping four ways to the center to a hole and a gate through which the rock is drawn as needed to an endless belt conveyor below. These conveyors dump into a cross conveyor which in turn delivers to an elevator and the latter finally drops the rock into steel bins in the drying room. These bins may be seen in the upper part and rear of the view showing the rotary driers. The clay is likewise delivered by a conveyor to the disintegrating rolls, making 1 in. lumps for the rotary driers. Storage bins for the dry clay have a capacity of 8000 tons.

The rotary driers are plain cylinders of sheet steel, 60 ft. long and 5 ft. in diameter. On the inside are six sets of lifting bars to expose all particles to the drying action. Around the outside is a girth gear and two tires which run on rolls. The tube is revolved by a spur gear operating with the girth gear at a speed of 3 r.p.m. The drier is mounted on an incline of ½ in. per ft. Its upper end extends into a chimney, through which the rock or clay is also fed. At the lower end is a stationary cap of fire-brick in which an oil-burner is inserted to dry the material. Thorough drying is a necessary preliminary to pulverization. The material gradually works down to the lower end and is discharged out through a hole in the bottom of the stationary cap and into a conveyor.

The rock drying room has three driers all belted through gearing to one 75 h.p. motor and the clay room is equipped with two driers driven by one 50 h.p. motor.



Rotary Driers, Conveyor Motors, Ball Mills and Tube Mills.

The conveyors are individually operated by induction motors of 50 and 75 h.p. capacity, conveniently located for accessibility.

The clay from the drier is taken by a conveyor to the next building where it is elevated into bins and from these delivered into one of two Williams mills, belt driven by 75 h.p. induction motors. These mills grind the clay so as to pass a 20-mesh screen. The material is then elevated to a spiral conveyor which takes it to three storage bins built of concrete and steel.

The rock from the driers is conveyed to steel bins placed above and behind the eight No. 8 Krupp ball

mills, pulverizing the rock so that it will pass a 20-mesh screen.

Each ball mill is belt driven by a 75 h.p. induction motor. This service is exceedingly severe for any machinery with high speed bearings, as the atmosphere is heavy with fine dust which settles like snow over everything and in the case of the motors can be seen trickling down over the coils and bearings at all times. Further than this, the motors are required to deliver continuously their rated load, without reference to temperature conditions of the air, for 24 hours per day and possibly for months at a stretch.

After leaving the ball mills the coarsely ground limestone is taken by conveyors, to elevators and finally through spiral conveyors to be delivered into the storage bins. There are four of these and they are similar to and in line with those in which the ground clay is placed. The capacity of the limestone bins is 2000 tons while that of the clay bins is one-half the amount.

The coarsely ground raw material is now ready for mixture. The clay and limestone are drawn from the bottom of their respective storage bins through rotary conveyors and elevated into steel bins, underneath each of which is a Richardson automatic weigher and into which the materials are delivered by a conveyor. The chemist adjusts these machines to receive a predetermined quantity, when the supply is automatically shut off. If one machine is loaded before the other, it waits until the other has received its charge and then both machines automatically dump into a steel hopper from which it is carried to a mixing machine which thoroughly mixes the ingredients in the proportion of about one of clay to three of limestone. The mixture is now taken by conveyors and elevators to the steel bins from which it is fed to the tube mills for further grinding to an impalpable powder.

There are twelve of these tube mills, ten being 5 ft. in diameter and two 7 ft., with a length of 22 ft. They are of riveted sheet steel and are placed horizontally. The lining is of silex blocks and the grinding is done with imported flint pebbles from 1½ to 3½ in. diameter. The tubes are surrounded with tires running on steel rollers and at the forward end is a large gear which engages with a pinion mounted on a shaft at the other end of which is a pulley. Belted to this pulley is a 75 h.p. induction motor which drives the mill. The two large mills which have been recently installed are each driven by a 200 h.p. induction motor. The small and large mills revolve, respectively, at 26 and 22 r.p.m.

Grinding in these mills is all done at the bottom, and is accomplished by attrition of the rolling pebbles and the concussion with the silex lining. The material passes through the entire length of the mill. At the forward end the material is discharged into spiral conveyors which in turn discharge it into elevators which carry it to the bins above the rotary kilns.

The Rotary Kilns.

There are eight rotary kilns placed parallel to each other and lengthwise of the mill. These kilns are 110 ft. long and 7½ ft. in diameter and consist of a tube of heavy riveted sheet steel supported by tires around the tube, which run on rollers. Near the central part of the tube is a girth gear driven by a spur gear in turn operated by a 50 h.p. variable speed reversible induction motor. These motors are operated through a resistance controller, near the fire or lower end of the tube, so that the attendant, who must at all times maintain a close observance of temperature and the condition of the furance interior, may regulate the speed of the kiln to suit these conditions. The speed variation permissible is in ten steps between a minimum of one-half r.p.m. to a maximum of one revolution in 45 seconds.

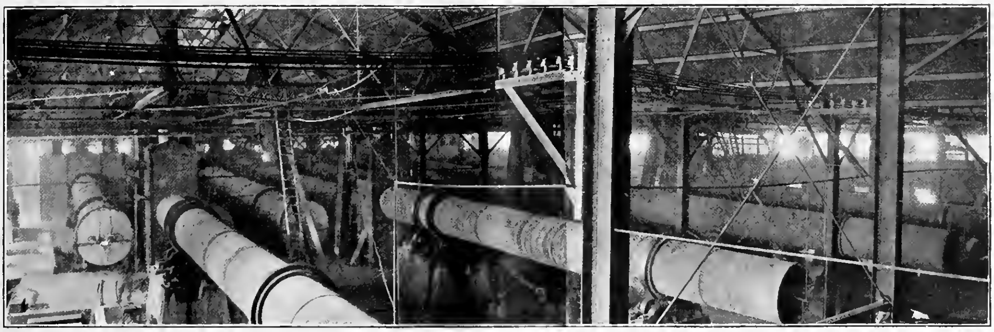
Rotary Kiln.

The kiln is inclined ½ in. per ft. from the upper or feed end to the fire or discharge end, to assist the movement of materials. The tube has a double lining of fire brick at the lower end to resist the great heat applied in calcination. The upper end of the tube extends into a massive brick chimney base on top of which is mounted the steel stacks which give the necessary draught and carry away moisture as well as the products of combustion. The lower end of the tube extends into a fire-brick cap or header with an opening for the oil burner.

The problem of supplying the heat for the kilns has been by no means easy of solution and there is yet much opportunity for improvement. In California, where oil is the only available fuel, fairly good results have been obtained after experimenting with various types of oil burners. Unlike the furnace under steam boilers, the form of which has the greatest bearing on the efficiency, all improvement must be made either in the burner itself or in varying the length or diameter of the kiln. It is impossible to change its form or the manner in which the natural material must receive its heat.

The kilns in this plant were originally equipped with Reid oil burners, consisting of a nozzle with an inner tube through which the oil was fed. This tube was placed within another tube which decreased in diameter towards the point of the nozzle. Through the space between the inner and outer tubes, air under high pressure formed a hollow stream about the oil stream and was supposed to act as an atomizer of the oil. This arrangement was unsatisfactory, as it was found that the air ring, instead of atomizing the oil, drove it in a solid stream far into the furnace, thus signally failing to accomplish the very purpose for which the burner was used.

In experimenting for better results the novel idea was suggested of reversing the air and oil, that is, of introducing the air through the center pipe and the oil through the outer chamber. Superior results from



General View of Kiln Mill Interior.

this change were immediately noticeable and this arrangement has been used ever since.

There are two air pressures used in operating the furnace, the high pressure at 80 lb. per sq. in., just mentioned and a low pressure large capacity supply at 36 oz., this is introduced from under the burner directly into the furnace to supply the air for combustion.

Fuel oil is delivered in tank cars to the plant and is stored in a 15,000 bbl. sheet steel tank to the north of the buildings, from which steam pumps deliver it to the burners through a coil of pipe in the chimney base of the clinker coolers, where steam from the cooling clinker pre-heats the oil.

The greatest attention has been paid to arrange the feed to the kiln in exact proportion to the speed of rotation. From the bottom of the bins which feed the kilns, material is carried by a spiral conveyor which closely fits the tube in which it acts; thus preventing irregularity in the movement of the material due to slippage past the spiral. This conveyor is driven from the same motor which operates the kiln, so that any variation in the speed of this motor will affect a proportional variation in the feed. The conveyor discharges into a cast iron pipe, inclined to 45 deg. with the horizontal, which extends into the upper end of the kiln. The material now travels slowly as the kiln revolves until it is charged in the form of clinker at the lower end, through an opening in the floor directly below the burner. During this movement through the kiln, the material is in constant contact with the hot gases which have a temperature of about 2600 deg. F. The first action is the driving off of all moisture and carbon dioxide, all organic matter is consumed, and is followed by the chemical processes necessary to make Portland cement.

Lime, which has been formed by the decomposition of the calcium carbonate, combines with the silica and alumina and probably the iron present and forms the clinker. This occurs near the end of the kiln at the point of greatest heat. The clinker, which is the objective result of all of the processes so far, is a dark greenish gray substance of spongy appearance; it is very hard and glitters when held in a strong light. The true chemical composition is a matter of much conjecture, but it is a compound of complex silicates of lime and alumina and also some aluminates of lime, other compounds which it may contain are of minor importance.

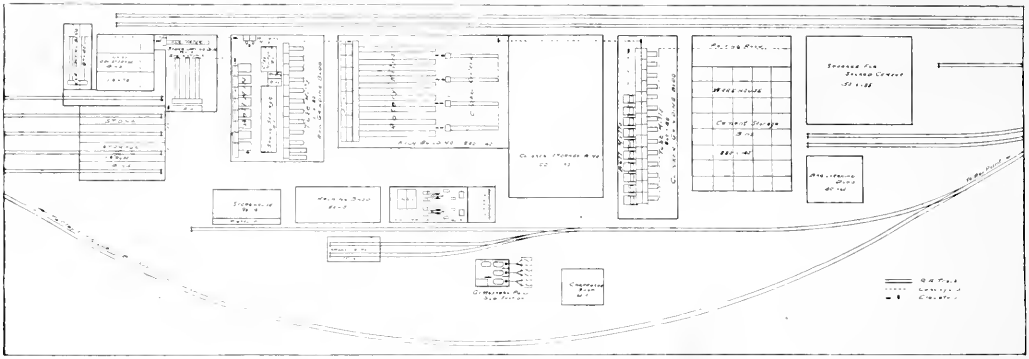
The clinker when it drops from the kilns is red-hot, retaining a temperature of about 2000 degrees F. It is picked up by a bucket elevator to be lifted and discharged into the rotary coolers. While the rotary kiln method of calcining is not as efficient in the use of fuel as some of the older methods employed in Europe, it is claimed by the operators, that the arrangement in use at this mill is producing clinker at a minimum cost per bbl. in comparison with other oil burning installations.

Rotary Coolers.

These serve a two-fold purpose in that they not only cool the hot clinker but also serve to disintegrate it through chemical action. The coolers are riveted sheet steel tubes, 5 ft. in diameter and 70 ft. long. There are four coolers placed in a row, being staggered line with the kilns. They are mounted like the rotary kilns and each is driven through gearing by an induction motor; they operate at 4 r. p.m. The interior is lined with hard cast iron sections and there are cast iron lifting plates projecting within the tube. The upper or intake end of the tube is slightly conical in shape and extends into a brick housing on which is mounted a steel stack. This is to create a draft through the cooler, and carry away steam and heat from the cooling clinker. At both ends of the tube are introduced water pipes which furnish a spray of water over the hot clinker. The lower end of the cooler is open and allows the clinker to discharge as it reaches that end.

The hot clinker from the kilns, which is in chunks from the size of a small button to that weighing a pound or more, is first sprayed with water; it is then carried up into the brick housing at the end of the cooler. The spraying forms steam and serves to cool and partly disintegrate the clinker. It is then discharged into a cast iron pipe which delivers it within the revolving cooler, where it receives more water.

In the gradual movement through the cooler, the clinker loses its heat and the water decomposes any free lime which may remain in the clinker. This decomposition causes a swelling of the lime particles and breaks the clinker up, greatly assisting in giving to the resulting cement the necessary permanence. The oil heating pipes before mentioned are contained in the brick header of the cooler and the heat which they absorb is derived from steam arising from the contact of water with hot clinker.



Sketch of Plant Layout.

It can be readily seen here that the proportion of free lime in the clinker must be as low as possible. This is what makes the process of calcining in the kilns of such great importance, as underburned clinker will necessarily contain large quantities of free lime.

Under the floor and running in a direction at right angles with the coolers below their lower or outlet end is a belt conveyor. The clinker discharges from the coolers, through openings in the floor, on this conveyor. It is then carried to an elevator and in turn discharged into several lines of conveyors equipped with automatic dumping machines to place the clinker in the storage bins where desired.

During the trip from the coolers to the storage bins the clinker all passes through a Richardson automatic recording weigher, which indicates the amount of cement which is being turned out by the mill each day.

Storage Bins.

The storage bins have a capacity of 100,000 bbl. Here the clinker is allowed to remain for several weeks. The process of lime reduction and disintegration which occurs in the coolers is continued here, moisture in the atmosphere acting on any free lime that may have remained. This seasoning not only assists in breaking up the clinker but gives assurance of a sound product in the finished cement.

Under the clinker bins are four lines of belt conveyors in tunnels. Openings in the bottom of the bins which may be closed or opened by gates, at will, control the discharge into the conveyors. These conveyors discharge into a main conveyor which carries the product through a tunnel into the next building for grinding and pulverizing.

Before delivering the clinker to the ball mills it is delivered into a steel bin. Adjoining this bin is a smaller bin containing gypsum. Under each of these bins is a Richardson automatic weighing machine, and here gypsum is added to the clinker to the amount of about 3 per cent to control the setting and hardening of the cement when used.

Gypsum rock is brought to the plant in cars and unloaded directly into a chute which passes it into a jaw crusher. Reduced to a proper size for mixing with the clinker, the gypsum is stored in a bin having a capacity for 300 tons. From this bin it is elevated by conveyor to the smaller of the weighing bins as needed. From the weighing machines the clinker and gypsum are dropped into a hopper and then mixed and the mixture is then elevated and conveyed to the sheet steel storage bins which supply the ball mills.

Ball and Tube Mills.

The process of grinding the gypsum and clinker mixture is similar to that already described for the raw grinding. The arrangement of both ball and tube mills is also practically the same. As there is no further mixture to be made however, there are no large storage bins between the two varieties of mill as is the case in the department where the raw grinding is done.

There are here 10 ball mills, each operated through belt drive, by a 75 h.p. induction motor. The product which is now a coarse blackish, somewhat sparkling powder, is taken from the ball mills on belt conveyors and then elevated and distributed into steel bins over the tube mills. It is discharged through chutes into these mills, to pass through as in the first instance, emerging as an impalpable powder, which must pass through a 100 mesh screen.

This powder is the finished Portland cement. The cement is now conveyed to the next building which contains the cement storage bins and bag filling apparatus.

Cement Storage Bins.

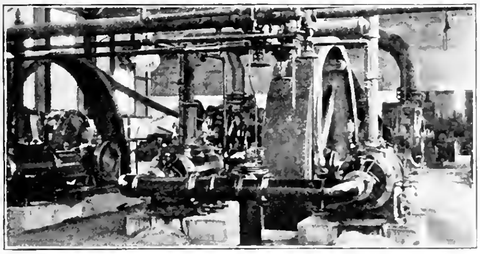
There are 40 of these bins, each having a capacity of 2700 bbl., or a total capacity of 108,000 bbl. The cement is elevated and distributed automatically into any bin desired. Before the work of filling a bin is commenced a sample of the cement is taken by a Meade automatic sampler and this sample is retained by the chemist for analysis. Cement remains in the bins for some time before it is sacked, to cool thoroughly, as the process of grinding imparts a temperature of about 200 deg. F. The storage also has a seasoning effect.

Openings in the bottom of the bins, which are controlled by sliding gates, are provided to draw the cement from the bins and it is taken on a belt conveyor, there being one conveyor under each row of bins, to Richardson automatic weighing machines. Under these is the sack filling apparatus and in filling a sack the weigher delivers 94 lb. of cement through a tube into the sack. The sacks are mounted on a re-

volving table and as each bag is filled, the table is revolved so as to place the next bag in position. After filling, the bag is tied and removed to the warehouse, and an empty bag substituted. The operation of filling is continuous and each machine handles from eight to ten bags per minute. The product is now finished and ready for shipment.

Compressor Plant.

Offset from the line of mill buildings and opposite the kiln house, is a separate building containing the compressor equipment, a pair of small steam boilers and the switchboard controlling all power circuits.



Compressor House Interior.

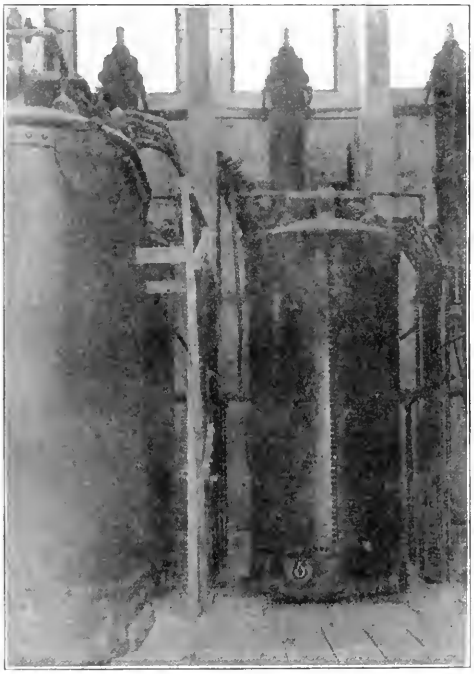
The boilers, having a total capacity of 110 b.h.p. each, are for the purpose of supplying steam for the Erie City oil pumps. In the compressor room there are two Ingersoll-Rand compressors supplying the high pressure air for the oil-burners at 80 lb. pressure and having a capacity of 700 cu. ft. of free air per minute. They are each belt driven by a 150 h.p. induction motor. The high pressure connection between the compressor house and the kilns is through a 6 in. steel pipe. There are also two No. 12 Sturtevant blowers, having a capacity of 8500 cu. ft. of free air per minute and supplying low pressure air to the kilns. Each blower is belt driven at 220 r.p.m., by a 150 h.p. induction motor. The connection between these blowers and the kilns is through an 18 in. cast iron pipe, supported on columns and carried above ground.

Power Supply.

A short distance from the compressor house and still further from the mill buildings is the concrete substation where electricity delivered from the lines of the Great Western Power Company is transformed to the operating voltage in use throughout the plant. The substation is a substantial and compact structure about 30 by 40 ft. and contains three single pole, piston type, oil switches for the high tension current, four 1000 kw. lowering transformers and a single panel switchboard with measuring instruments and oil switch. There is also a small operator's room and telephone booth.

The transmission line supplying this substation is a branch from the main line of the supply company which passes over the hill three-quarters of a mile south of the plant. The branch line is about a mile in length and is a steel tower equipment similar in all respects, save the size of conductor, to the main line and like the main line has two circuits.

Immediately in the rear of the substation is an angle steel structure on which are mounted two sets of Pacific Electric Switch Company's out-door disconnecting switches. The transmission circuits are brought to these switches and from them a common line is taken through openings into the building and directly connected to the single pole oil switches. The wall openings are 5 ft. square, glazed with plate glass, having a hole in the center through which the conductor passes. Between each pair of oil switches is a concrete barrier and in front, but below the switch, is placed its respective transformer, the fourth transformer being a spare. The switches and transformers were supplied by the General Electric Company. The transformers are star connected on the high tension side to the transmission line which delivers three-phase currents at a potential of 100,000 volts. The low-tension side of the transformers are delta connected and deliver three-phase currents to the company's switchboard at a potential of 440 volts.

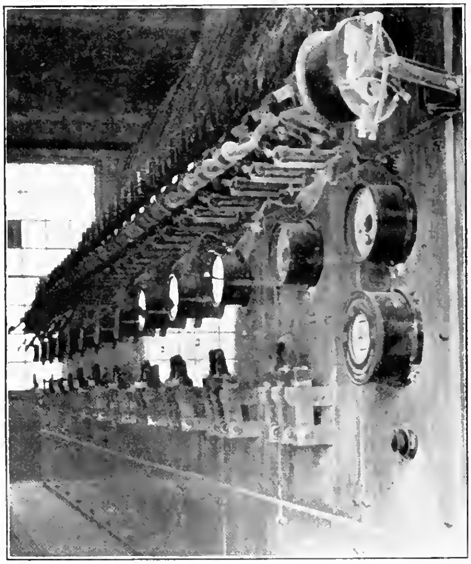


Transformers in Sub-Station.

Switchboard and Electrical Equipment.

Extending the width of the compressor house, but divided from it by a fireproof concrete wall, is the switchboard, consisting of 14 panels of blue Vermont marble. The first panel is devoted to the control and measurement of the incoming circuit from the substation, and is equipped with an ampere meter, a frequency meter, one polyphase integrating switchboard type wattmeter, 3-pole oil switch and one volt meter mounted on a swinging arm. The remaining thirteen

panels are alike and on each is mounted one automatic overload circuit-breaker, one ampere meter and one 3-pole oil switch. On the wall facing the switchboard is mounted one recording frequency meter. In the rear of and extending throughout its length are three massive bus-bars of laminated copper. This installation was furnished by the Westinghouse Electric & Manufacturing Company with the exception of the frequency meter which was supplied by the General Electric Company. At another point mounted on the concrete wall of the building, but convenient to the master panel of the switchboard is a pair of General Electric integrating wattmeters installed by the power supply company which serve to check the reading of the panel meter. The kw. hour charge is taken from these meters.



Switchboard.

Circuits to the various mills are invariably rubber and weatherproof covered copper cable and are supported on structural brackets and insulators fastened to the buildings about 20 ft. above the ground. The various circuits are carried to their respective motors in the same manner, care being taken to place the wiring in position to prevent any possible injury. The leads in most cases are carried through tubing below the concrete floors and run thus to a point of outlet at the motor or the controller.

All of the motors are of the induction type and all but those operating the rotary kilns are constant speed with squirrel cage rotors. The kiln motors are variable speed and reversible, and their controllers are of the grid resistance type placed at the lower end of the kiln and about 100 ft. from the motor. The controllers for the constant speed motors are in some cases mounted adjacent to the motor, as for those operating conveyors. In the ball mills the controllers are all mounted on the passageway side of the concrete piers supporting the pulley bearings. In the tube and drying mills the controllers for all of the motors are mounted on a platform at one side in a group. All motors have two bearings with the pulley overhanging; all deliver their power through belt drive. The speeds of different motors vary somewhat, although the predominating speed is 660 r.p.m. The voltage is 440 in all cases.

The service requirement is severe as all motors may be called upon to constantly deliver their full load for an indefinite time; ventilation in many places is limited and at times the surrounding temperature is high. As a rule the actual load upon the motor is somewhat under the full load rating.

The total power load will average about 3000 kw. or 4000 h.p. As the daily capacity of the plant is 4000 barrels of cement, it is seen that one barrel of cement requires 1 h.p. day of power, or in other words, the power capacity required to operate a cement mill is equal in horsepower to the daily barrel capacity of the mill. Reduced to figures the cost of electricity to produce a barrel of cement is about 12.6 cents. The total cost of producing a barrel of cement under conditions generally met with in California is under $1.00.

The motor equipment was all manufactured by the Allis-Chalmers Company, who also built much of the machinery used throughout the mill. Following is a list of the motor sizes and their application.

Apparatus driven.	No. of motors	Size of motor.
No. 9 crusher	1	150 h.p.
No. 6 crushers	2	75 h.p.
Bunker conveyors	2	30 h.p.
Driers	5	75 h.p.
Wilson mills	2	75 h.p.
Ball mills	18	50 h.p.
Tube mills	20	75 h.p.
Tube mills	2	200 h.p.
Rotary coolers	4	50 h.p.
Rotary coolers	8	50 h.p.
Compressors	2	150 h.p.
Rotary blowers	2	150 h.p.
Carpenter shop	1	20 h.p.
Machine shop	1	30 h.p.
Conveyors	1	30 h.p.
Conveyors	8	50 h.p.
Conveyors	2	50 h.p.
Conveyors	4	15 h.p.
Sewing machine (bag)	1	½ h.p.
Pump house	1	50 h.p.
Pump house	4	5 h.p.
Total	90	5645.5

Water Supply.

The water supply for all purposes is drawn from wells about one-half mile from the mill. The pump house at this point is a corrugated iron structure and is equipped with five pumping rigs. There are four artesian wells and the water is lifted from each by a Gould deep well pump and each is driven by a 5 h.p., 3-phase induction motor. There is in addition a Gould 5 by 8 triplex pump which forces the water through the service pipe to the works. This pump is driven by a 50 h.p. induction motor. All of these motors operate at 440 volts.

The writer is indebted to Mr. Anson George, of the company, and to Mr. U. I. Leh, the general superintendent, for every assistance and courtesy, and much valuable information on the theory and methods in use in the manufacture of Portland cement.

OIL BURNING LOCOMOTIVE PRACTICE.[1]

BY HOWARD STILLMAN.

(Concluded.)

Fire-box repairs to oil burning locomotives do not exceed that of coal burning engines. From records kept of cost of maintenance of coal vs. oil burning engines, we know that if a furnace is properly equipped with draft adjustment and burner, that an oil burning fire-box will outlast a fire-box burning coal; that is to say on the same class of engine in the same service. However it cost a good many fire-boxes to determine the best arrangement. In this connection I wish to draw emphasis to the fact that the oil fireman is a large factor in successful oil burning practice on locomotives. The condition is a very different proposition from that of oil firing on stationary boilers. Conditions are constantly varying in the locomotive engine, depending on load and speed, regularity of service, condition of track, grade, and rules of the road. The oil fireman must necessarily watch the operation of the locomotive with intelligence and every movement of the engineer demands corresponding regulation of the oil fire and watchfulness on the part of the fireman. He has two gauges to guide him, the steam gauge and top of the stack show results, the desired steam pressure with least smoke being the objective. It will be appreciated, therefore, when I say that the personal equation enters largely into successful practice with burning oil on a locomotive. A careless fireman can do great damage to the fire-box and flues if he neglects attention to regulation of dampers and regulators at the proper time. It is not always possible to meet the demand for steam without smoke and it is a general though not universal condition that the locomotive should give a thin gray smoke.

As before stated our locomotives are converted coal burners with long two-inch flues and comparatively short furnaces. From the nature of oil fuel and the necessity of proper mingling of air with hydrocarbon vapors for the proper combustion, it is my opinion that greater depth of fire-box is essential for economic oil burning than for coal. The purpose of the flues is to absorb heat from gases leaving the fire-box space, and if the flues are fulfilling their purpose in absorbing heat the temperature falls rapidly. If combustion is not approaching completion when the gases enter flues, the vapors in process of combustion fall in temperature below that required for oxidation of the carbon hence it is precipitated as soot or black smoke. While this is a common phenomenon of smoke production with any fuel, it is more in evidence with oil than solid fuel where we have nothing to burn but volatile combustible. Lack of oxygen is generally supposed to be the cause of smoke but lack of proper temperature required for chemical combination is as often if not oftener, the cause. The lack of sufficient fire-box volume is in my opinion the common cause of smoke in oil burning locomotives when the greater demands are made on the boiler for rapid evaporation. The deposit of soot upon locomotive flues is a common difficulty in our service owing to the non-conducting nature of this deposit, and rapid falling off of steaming quality from this cause. This calls for frequent and regular sanding of flues.

[1]Paper presented at San Francisco meeting American Society of Mechanical Engineers, March 10, 1911.

In oil burning we meet with other conditions peculiar to this fuel and distinct from coal. The factor of grate surface disappears. The grates are bricked over and air admission regulated through openings and proper dampers. We have no function corresponding to grate surface that conveys meaning. The item of heating surface only remains on which to base comparisons.

The rate of combustion on the locomotive, like other functions, depends on the service and size of the machine. While the principles of combustion do not vary in locomotive boilers from those in stationary service, there is a wide variation in the rate of steam production, independent of the kind of fuel used. With the modern locomotive in main line service the demand for steam at full pressure per unit of heating surface far exceeds, in point of time, the product of a stationary boiler. The demand on the locomotive is intermittent and conditions vary from an enormous rate of steam production when working at a rate of maximum effort, to one of comparative rest.

A large number of locomotive tests have been made by us covering the use of oil fuel as well as in comparison with coal. A full record of these tests would occupy too much space and time here but I have the following data to submit, showing evaporative results on most recent tests covering about the heaviest oil firing which we have, covering the crossing of the Sierra Nevadas.

DATA FROM EVAPORATIVE TESTS COVERING SERVICE OF LOCOMOTIVES CROSSING THE SIERRA NEVADAS, SACRAMENTO DIVISION, S. P. CO.

Number of single trips in test	2	2	2
Total time of test	17 h. 39 m.	21 h. 23 m.	29 h. 2 m
Actual running time	13 h. 55 m.	12 h. 59 m.	18 h. 11 m.
Miles run	315	174	174
Average steam pressure (gauge) lbs.	156.0	196.1	194.5
Smoke-box temperature, degrees F.	797	738.5	451.3
Total gallons water evaporated	44147	48103	91087
Total pounds water evaporated	367642	400858	759058
Total gallons oil burned	3951.6	4328.4	7692.1
Total pounds oil burned	31613	34627	61537
Equivalent evaporation, lbs. water per lb. oil	14.14	13.95	15.04
Lbs. water evaporated per sq. ft. heat surf. per hr.	8.698	8.809	6.392
Lbs. oil burned per sq. ft. heat surf. per hr.	0.748	0.761	0.518
Number of cars in train	7	14.5	24.5
Weight of train, tons	342	481	1056
Gross ton mileage	107730	83694	183744
Gallons water evaporated per 1000 ton miles	409.79	574.75	495.73
Pounds water evaporated per 1000 ton miles	3413	4790	4131
Gallons fuel oil burned per 1000 ton miles	34.90	48.40	39.51
Pounds fuel oil burned per 1000 ton miles	279.20	387.20	316.08
Boiler efficiency	73.84%	72.82%	78.52%
Maximum indicated horsepower	1719	1470	2486
Mean indicated horsepower	1368	1222	2057
Dimensions of Locomotives— Engine number	2315	2564	4001
Size of cylinders	22in x28in.	22in.x30in.	26in. and 40in.x30in.
Diameter of drivers	63 in.	57 in.	57 in.
Total weight of locomotive, lbs.	202300	208000	425900
Weight of drivers, lbs.	160000	187000	394150
Weight of tender, lbs.	138070	134745	169765
Total heating surface, sq. ft.	2994	3403	6394
Feed water heater, heating surface, sq. ft.	None	None	1221

NOTE:—Train weights are the average for the distance hauled and are exclusive of engine and tender. Tests made under ordinary service conditions. Engines manned. In "Water evaporated and oil burned per sq. ft. heat surface per hour," the figures are for actual running time, the allowance of 15 gals. of oil and its equivalent in water is made per hour while standing. In "Gals. and lbs. oil per 1000 ton miles," a deduction is made of 15 gals. per hour while standing and 3.5% of oil for evaporating steam for atomizing oil. Quantity of oil burned corrected to normal temperature of 70° F. All measuring instruments calibrated.

Comparisons of coal vs. oil from an economic standpoint are most interesting where the two fuels

come in competition, and relative values must largely depend on conditions and form of boilers under which either fuel is burned. We find some engine boilers to be better adapted for coal than oil or vice versa depending on construction. Comparisons therefore are to some degree a function of the boiler itself. We went into this quite thoroughly when our locomotives were converted. Of late years we have used no coal hence the following are not recent. The figures are based on evaporative tests we have made on our locomotives before and after conversion. The comparisons are made with ordinary bituminous coal of about 13,350 B.t.u.

Type of Locomotive.	Number in Service.	Evaporation—2000 lbs. coal equivalent to fuel oil.
Eight-wheel 18-24	50	144 gals.
Ten-wheel	294	151 gals.
Mogul	176	146 gals.
Twelve-wheel	67	158 gals.
Consolidation	139	162 gals.
Atlantic	19	144 gals.

The total number of locomotives above accounted for is 745, and the mean equivalent is 152 gallons or 3.62 barrels of 42 gallons, equivalent in heat value to 2000 lb. coal. The average equivalent figures above stated cover much careful work and are based on equivalent evaporative results from many service tests. It should be borne in mind that the above figures are from service tests and represent oil burned on the main line between terminals only and do not represent losses in transfer, handling or firing up, etc. Our accounting department use a figure af 168 gallons or 4 barrels of oil equivalent to one ton of coal.

It may be said that with oil fuel, providing engines are burning it with a fair degree of efficiency, that the quality of fuel is a constant factor. Poor or bad coal as accounting for engine failures drops from the delay report—"cleaning fires" is abolished.

Concerning relative values of coal vs. oil fuel I cannot close without submitting the following table of results with either fuel on the Southern Pacific Company's bay steamers, the figures showing the last six month record with coal in the year 1901 compared with last six months in oil of year 1908.

RECORD OF COAL BURNED DURING LAST SIX MONTHS USED, 1901, AND OIL BURNED DURING LAST SIX MONTHS OF 1908, ON STEAMERS OF S. P. CO.

Berkeley	2,764	18,592	6.72	11,207	21,130	1.89	3.56
Piedmont	4,223	19,548	4.63	15,414	20,808	1.35	3.43
Oakland	3,209	18,348	5.72	13,603	19,894	1.46	3.92
Bay City	2,889	21,536	7.45	11,548	20,943	1.81	4.12
Encinal	3,703	20,284	5.47	10,512	19,678	1.87	2.93
Newark	1,860	9,372	5.04	6,559	10,631	1.62	3.11
Transit	2,581	16,715	6.48	9,548	17,922	1.88	3.45
El Capitan	1,019	7,238	7.10	3,431	6,072	1.77	4.01
Solano	4,516	5,480	1.21	17,151	7,143	.42	2.88
Apache	1,971	18,992	9.64	7,996	21,380	2.67	3.61
Modoc	2,265	20,685	9.13	7,682	21,170	2.76	3.31
Totals & resultant means	31,000	176,790	5.70	114,651	186,771	1.63	....

Mean equivalent of one ton of coal in barrels of oil, 3.495

These figures are not from evaporative tests but cover the service of eleven steam boats, a total of 176,790 miles as coal burners, and 186,771 miles as oil burners. The figures are from the official accounting record.

The above service of these bay steamers represents a consumption per year of 229,302 barrels, which, added to my former figure per year for locomotives gives a total of 8,363,802 barrels per year consumed by us. In addition to this a considerable amount is used in shops and rolling mills.

MAKING PRODUCER GAS FROM OIL.[1]

BY W. H. FROST.

When first considering the subject of making producer gas from oil, the matter primarily appealed to me commercially, as it meant a fuel economy two to three times better than the average steam plant, or would substitute crude oil for an equal volume of distillate or gasoline in the distillate engines.

As a gas engine builder I started out, not so much to design merely a new method of making gas, as to produce a new power system in which the relation of producer to engine, and vice versa, must be the first consideration. The question was how to do this. Certainly not with any of the so-called "crude oil generators" at that time in the market.

From data collected in the field, and from many practical experiments, it was evident that such a process was simply a crude method of distillation, sending over indigestible compounds to the engine, and wasting most of the oil as a by-product. When a refined product providing a suitable vapor was used, it was found cheaper and much less trouble to use the properly refined and cleaned distillate direct in the cylinder.

Illuminating gas had proven a failure in any but small engines, on account of the large proportion of hydrogen (30 to 60 per cent) causing premature explosions on compression, while the involved process and bulky apparatus, with the offensive waste gases and tarry products, the voluminous scrubbers and filters and the many objections to a gas holder, put all that had been accomplished in that line out of the question.

The gas giving the best results in every way in gas engines was from blast furnaces, its principal combustible being carbon-monoxide. The most successful coal gas producers made a gas in which this was a principal element. No successful method of producing a suitable power gas from crude oil was known.

As a practical gas engine builder and distributor, I knew that no complicated apparatus, nor any requiring particular skill to operate it, would prove a commercial success. Certain things were necessary:

1st. To produce the gas continuously in the quantity required by the engine, dispensing with storage.

2nd. The gas to contain the maximum of carbon monoxide and the minimum of hydrogen, to obtain highest thermal efficiency and best regulation of engine.

3rd. Gas to be practically even in quality to prevent shut-downs.

4th. Gas to be clean, as very minute particles of carbon accumulate and foul engine valves, necessitating shut-downs and cleaning.

5th. Apparatus to occupy relatively small space.

6th. Operation to be simple, readily understood by ordinary attendant and requiring minimum of attention.

7th. Dispense with offensive fumes and by-products.

[1]Paper presented at San Francisco meeting American Society of Mechanical Engineers, March 10, 1911.

8th. Reduce the necessary elements to the minimum.

Oil carries carbon, and the oxygen of the atmosphere is free for the taking everywhere, and these two elements are the only ones necessary. Many forms of apparatus may be used. That seeming most satisfactory is a simple open chamber into which the oil is sprayed by compressed air and open to the atmosphere through regulatable means. Suction is produced by the engine or any form of suitable exhauster. This keeps the interior of the producer at or below atmospheric pressure.

The oxygen in the air flowing into the producer, and used in spraying the oil, unites with a certain portion of the oil to produce combustion and a high temperature. In this high temperature zone the unburnt oil is decomposed into its gaseous elements and free carbon. The carbon dioxide formed by the combustion evidently selects carbon from the products of the oil's decomposition to form carbon monoxide. An average analysis of the gas gives:

Carbon dioxide	6.
Oxygen	1.
Illuminants	2.2
Carbon monoxide	13.6
Hydrogen	6.2
Methane	3.3
Nitrogen	67.7
	100.
141 B.t.u.	

Regulation of the free air openings, and of the oil, controls the quality and also the volume of gas, and can be automatically governed by the engine. A test flame kept burning is an indication to the attendant of the quality of the gas. Sight holes also show the internal condition of the producer. Gas can be made as lean as wanted and up to considerably over 200 B.t.u. It is evident that the addition of steam would raise the B.t.u. value, but means another element to generate and control, and increases the hydrogen. Personally, I do not favor it for power gas.

During the experiments and tests of several years' duration, it was found that engines operated most steadily and evenly, and the apparatus required the least attention, when the temperature of the producer was sufficiently high to completely break up the tarry vapors into gas and carbon. This carbon, by the way, is a new product, and has many valuable applications.

The most difficult task was to completely separate the fine, almost microscopic, particles of carbon from the gas, so that it would be perfectly clean and suited to any gas engine, as it is well known that most American engine valves are designed for use with natural gas, which is perfectly clean. Eventually, a centrifugal scrubber of simple design was devised, which absolutely cleans the gas, so much so that fine white muslin held for one or two minutes over a 1-in. outlet with gas under 2 in. water pressure, sufficient to make a very long flame, shows no stain whatever, and if kept there for two hours, shows only a slight discoloration. The scrubber doing this is about 4 ft. diameter by 5 ft. long, and cleans about 35,000 cu. ft. of gas per hour.

The fine dry carbon, free from tar, is collected from the wash water by any convenient means. In a plant of 500 h.p., it is not sufficient in quantity to require any special separating device, but is collected in a skimming tank in the usual manner. As previously stated, this fine clean carbon has many valuable uses, particularly in paint for metal or wood, such paint being water and weather proof, very elastic and of great penetrative power. If obtained in sufficient quantity, it may be used as fuel.

The economy, of course, varies with the engine, but actual runs on plants of 100 to 500 h.p. show that 1 lb. of oil, or a trifle over, produces a brake h.p. in a fairly economical engine, charging the power required to operate the producer auxiliaries to the engine. A guarantee of 1⅛ lb. is perfectly safe. Undoubtedly the experience already gained can be utilized in designing engines to obtain a much higher efficiency, as well as to increase the efficiency of the producer.

As to sizes of producers: with a circular chamber less than 18 in. diameter by 4 ft. long or about 7 cu. ft. capacity, I have made the gas required to operate a 150 h.p. engine full load, but prefer larger capacity, at least for the present.

No absolute measurements of gas volumes have been made, owing to the large quantities handled, but reckoning the engine to require 12,000 B.t.u. for each b.h.p., actual runs show that 1 lb. of crude oil produces this gas and more, or 3,900,000 B.t.u. to one 325-lb. bbl. I understand that 1000 cu. ft. of 600 B.t.u. illuminating gas requires from 8 to 10 gallons of crude oil, utilizing from 2,520,000 to 3,150,000 B.t.u. per bbl. of oil, showing this producer gas process to have a thermal efficiency 33 to 54 per cent greater than illuminating gas process, indicating, with its further advantage of simple apparatus, that it has a wide field of application as a fuel gas.

Practically all kinds and gravities of crude oils have been used, as well as oil from which the light products had been taken. It seems that the only necessary ingredient is carbon. The effect of a general introduction of a practical oil-gas power system with its economies means a great deal to the manufacturing industries of the Pacific Coast, and I feel that the system which I have described has already been demonstrated to be a success, both from an operating and an economic standpoint.

I should also like to comment on the paper read by Mr. Jones at the last meeting.[1] Speaking of the producer gas which he has made, he states: "The operation is continuous, and without interruptions for cleaning. This is essential in the manufacture of producer gas for power purposes." Quoting again: "Any accumulation of carbon in the generator may be removed by adjusting the temperature and quantity of air supplied." This indicates that there is a necessity for cleaning, but that a change in proportion of air, with consequent change in temperature (probably more air raises the temperature) consumes the accumulated deposits. My experience has been that any change in temperature, or proportion of elements, changes the quality of the gas and causes shut-down of the engine. (The change mentioned would probably make the gas leaner.)

The only way to avoid serious engine troubles would be to build storage sufficient to give time so that the changes of gas values would be very slow and

[1]Journal of Electricity, Power and Gas, March 25, 1911, page 269.

gradual, and even then the load must never be greater than the leanest gas will carry, and the engine would require close attention and skilful handling. Even if the leanest gas can be kept up to 160 B.t.u., it would require 37,500 cu. ft. per hour for a 500 h.p. load (12,000 B.t.u. per b.h.p.), making an enormous storage necessary to even approximately average the gas.

The statement of the necessity of changes also shows that this is not a continuous process producing a uniform gas, but that it is a process producing a continuous supply of gases of varying values, whereas a continuous supply of a practically uniform gas is absolutely essential to any engine I have ever operated.

Quoting again from Mr. Jones' paper: "Making producer gas from oil in the ordinary gas generator has many advantages over any special process." What are the advantages? What power plant would want such an equipment as is required for illuminating gas making? Bulky retorts, large scrubbers and filters for the great volume of gas required and big gas holders, necessary for all pressure systems and also to average the quality of gas.

The paper indicates that certain results have been accomplished. The vital lack in the statement is that gas engines were successfully operating with this gas. The tendency of the gas engineer is to concentrate upon the gas process without taking into account the requirements and limitations of the gas engine and the actual demands of a power plant. The engine and producer are so intimately related that it is quite out of the question to divorce them, even in California.

Illuminating gas apparatus is best adapted to the making of illuminating gas, a very different product from producer gas, while producer gas apparatus specially designed to meet power plant requirements is best for that service.

Evidently a by-product of lamp black or tar or both is produced and must be separated by washing and filtering to fit it for the engine. Evidently the process does not produce an even and uniform gas continuously. Evidently Mr. Jones relies upon the gas holder for averaging the gas, same as is done with illuminating gas, but this is expensive, and impracticable with a power plant of average size, and an impossibility within the fire limits of cities.

A GUN IN TEXAS.

"Calculus is like the Texan's gun, which he may carry for three or four years without ever having occasion for its use, but when he does need it he needs it badly." An unfortunate young man once went to Texas, where, in accordance with time honored tradition, he purchased a six-shooter, with trousers to fit. For three years and two days he carried it wherever he went, blest with that serenity of mind which springs from a consciousness of security and peace, for he had but to slap his thigh to know that the faithful weapon was ever ready for the hour of need. On the second day of the fourth year the crisis came. Out from its holster leaped the rusty gun. But, alas for my friend! His finger fumbled for the trigger, the action was hard, the barrel foul. At this season of the year when the seed is going under ground, sad memories arise, because they also planted him. The moral is obvious.

DISCUSSIONS SAN FRANCISCO MEETING, A. S. M. E.

Relative Value of Light Oil As Compared With Heavy Oil.[1]

C. R. Weymouth: Professor Le Conte's paper gives information regarding the heating value of oils of various gravities, of utmost valne to mechanical engineers and power plant operators. If we assume that the range of fuel oil ordinarily varies between the limits of 12 deg. and 18 deg. Baume, we find, in accordance with his Table 1, an increase of 2.18 per cent in the total heat units per barrel, in favor of the heavier oil. So long as the barrel is the unit in the purchase of oil, power plant operators cannot ignore this comparison.

Since the reading of these papers the writer has endeavored to collect data in an attempt to establish a relation between the specific gravity of California crude oil, Baume scale, and the percentage of hydrogen shown by its ultimate analysis; this, in order to compute a table showing the "available heat" per pound and per barrel of crude oil, of varying gravities, correcting for loss due to latent heat of steam formed by the combustion of hydrogen, as pointed out in the writer's paper presented at the same meeting.

It is found that there is no exact relationship between the specific gravity of crude oil and its hydrogen content, although there is a general tendency for an increase in hydrogen content, with the lighter oils.

Examination of the ultimate analysis and calorimeter tests of a number of California crude oils indicates the rather startling fact that it is possible in oils having practically the same total quantity of inert constituents, to have a variation in both hydrogen and carbon contents with practically no variation in the calorific value of the oil.

The inevitable conclusions that the calorific value of crude oil does not correspond to the heat of combustion of its elemental constituents, and that accepted formulae for calculating the total heat of fuels are not applicable to California crude oils, are borne out by the fact that the calculated calorific value was, in one instance, 8.7 per cent greater than obtained from calorimeter test.

This apparent anomaly is no doubt explained by the fact that crude oil is an admixture of various hydro-carbons, and that the heat required in the formation of these hydro-carbons is not available in the further combustion as crude oil.

From Prof. Le Conte's table, the writer calculated the variation in hydrogen due to variation in heat units, according to Favre and Silberman's formulae, the result being an increase of 1.263 per cent hydrogen for 10 deg. increase Be. From the foregoing it is evident that this relationship cannot be regarded as more than an approximation. On this basis, and correcting for latent heat of steam only, the "available heat" per barrel of oil is 2.32 per cent greater for 12 deg. Be. oil than for 18 deg. Be. oil.

If further corrections be made for the added stack losses at a temperature of 400 deg. F. due to the greater air required for combustion, then 12 deg. Be. oil has an advantage over 18 deg. Be. oil of 2.37 per cent.

It should be evident from the wide scattering of the hydrogen points that the comparison of any two oils under consideration should be made with respect to their individual analyses, and not with respect to the average line mentioned. For example, from the plotted points a hydrogen variation of 1.8 per cent is noticeable with practically no variation on the Baume scale, corresponding to which the stated increase of hydrogen involves a commercial loss, due to its lower "available heat," and increased chimney losses, of approximately 1 per cent. Taking into consideration this loss and the greater heat units of heavy oils, the extreme variation in the commercial value of anhydrous crude oils, between the limits of 12 deg. Be. and 18 deg. Be., appears to be not greater than 3 per cent.

[1] Journal of Electricity, Power and Gas, March 18, 1911.

As a result of all the tests by Chas. C. Moore & Co., engineers, and the Babcock & Wilcox Co., with California crude oils, it is not apparent that the above conclusions will be materially modified by a consideration of the atomizing agent, when oils are heated to the proper temperature before firing.

It should be noted that Prof. Le Conte's table is intended to represent a general average, the line being drawn through plotted points considerably scattered. Calorimeter determinations will still be necessary as the specific gravity of an oil is not an accurate index of its calorific value.

"Stacks for Oil Burning Boilers."[1]

C. R. Weymouth: Mr. Dunn has fairly represented current practice in the design of chimneys for oil fired boilers at sea level, for moderate sized plants. About eight years ago, the writer established, for Chas. C. Moore & Co., engineers, a rule for oil burning chimneys, as set forth in Mr. Dunn's paper, and while such basis for the selection of chimneys has kept them out of difficulties, recent investigations have indicated the desirability for a radical departure from this rule in certain special instances.

During the last four years the writer has been collecting data as to the performance of chimneys in connection with oil burning plants, and about two years ago began the preparation of a paper setting forth, in detail, the results of these investigations, which will later be presented to the Society.

For the benefit of those who contemplate using Kent's table as a basis of selection of chimneys for oil burning plants, the writer would state that Mr. Dunn's explanation of the reasons for adducing the rule stated, is hardly correct. The weight of chimney gases per boiler horsepower, when burning coal, is not twice that when burning oil. It is possible to use chimneys of smaller area for oil burning than for coal burning, by reason of the much lower draft required for oil burning, permitting higher velocities in the chimney, and a greater percentage of draft loss in the chimney proper.

Mr. Kent probably never intended the widespread usage accorded his table of chimney capacities, and before adopting this for too general usage, engineers would do well to inquire the basis of development of Kent's table of chimney capacities, and the significance of the figures given.

According to Kent's table, a chimney 48 in. in diameter by 100 ft. in height, is rated at 348 commercial horsepower. According to Mr. Dunn's paper, this chimney would develop double that amount, or practically 700 boiler horsepower. The questions arise: Should this chimney be connected to boilers aggregating 700 h.p. based on the normal rating? Will it merely carry boilers when operating at rating, or does it provide a margin for overload, and if so, to what extent? Were it desirable, in such a plant, to operate both boilers temporarily at 100 per cent overload, developing 1400 boiler horsepower, would it be necessary to install a chimney of double the sectional area?

The writer no longer uses Kent's table for selecting chimneys for oil fired boilers, and it is not possible to obtain correct ratings for oil chimneys by applying a fixed ratio to the capacity set forth in it.

With economical firing, and with properly designed furnaces, the draft in the third pass, required to burn oil in a Babcock & Wilcox boiler of, say, 250 h.p. rating, is about .1 in. If this boiler be connected to a chimney 100 ft. in height, giving a working draft at the base of the chimney of, say, .5 in., it is evident that this surplus draft is capable of flooding the boiler with an excess of air, if the draft be not properly regulated. Such operation could easily result in such a large excess of air for combustion as to require the burning of 10 per cent excess oil, merely to heat to the stack temperature the excess air so admitted.

If for the given single boiler the chimney height be reduced to approximately 35 ft., the boiler outlet and breeching being of ample area, and the stack being directly connected to the boiler, the chimney would then produce a maximum draft practically equivalent to that required for the operation of the boiler at rating; and with boiler damper and ash pit doors wide open it would be impossible for the most careless firemen to flood the furnaces with any material excess of air. The writer does not recommend that all chimney heights be reduced to 35 ft., but this illustration serves to indicate an extent of safeguarding the fuel economy of the boiler room, not possible by any other simple means.

In a San Francisco office building it was found necessary, by reason of the height of the building, to install a chimney extending more than 200 ft. above the boiler room floor line. On one occasion the analysis of flue gases, in connection with this chimney, indicated 200 per cent air over actual requirements, and a certain fuel loss, as compared with economical firing, of at least 20 per cent. While, in this instance, it was impossible to reduce the height of the chimney, it would have been possible to reduce the diameter of the chimney to such an extent, that the chimney friction would have reduced the available draft at the base of the chimney, to an amount more nearly in keeping with the boiler requirements.

As illustrating the overloading and abuse of boilers possible with excessive drafts, the writer has in mind a Stirling boiler having a connected chimney of generous diameter, 80 ft. in height. The damper lever had been disconnected, and the boiler fired with both rear damper and ash doors wide open. The fireman was instructed in the regulation of dampers and ash doors, but failed to observe these instructions. Subsequent tests indicated overloads, of several hours' duration, of 85 per cent, and momentary overloads of even greater extent. There were other boilers in service, having less draft power, which were not overloaded to this extent. In the plant in question, all boilers should have been operated at practically rating, on a nearly uniform factory load. Obviously, the overloading of this particular boiler led to a considerable fuel loss. To obviate these difficulties, the writer has recently recommended a 40 ft. reduction in the height of this chimney. A greater reduction would be possible, from the boiler standpoint, but in this instance limited by height of building.

When operating boilers under variable load, a careless fireman is liable to discover that the steam gauge reads five or six pounds low, and rapidly falling. Through habit, he has learned that this loss can be overcome by a few moments' heavy firing. During such periods, the boiler is frequently fired at from 200 to 300 per cent rating, and boiler tube renewals are many times chargeable to this cause, not to mention excessive oil consumption resulting from such practice.

While a certain excess draft is necessary for proper regulation of boiler plants, on variable load, it is self-evident that an excessive draft can only lead to severe abuse of boilers in the hands of ordinary firemen.

Prior to the burning of oil in Pacific Coast plants, chimneys were proportioned for coal burning practice, and in many instances the subsequent failure to obtain favorable economy with oil fuel, in everyday work, was attributable to tall chimneys. In a number of these stations it was later found possible to largely increase the number of boilers connected to the one chimney; the station economy was improved without apparent effort of the firemen, this owing to the fact that the increased volume of gases passing through the flues and chimney reduced the draft available at the boiler outlet, and at once limited the extent of flooding the furnaces with excess air, formerly possible with an excessive draft.

It has been found by experiment that the draft necessary for the combustion of oil varies largely with the economy of firing, and in one series of tests, operating the same boiler at approximately rated capacity, the draft varied from less than .1 in. with economical firing, to nearly .5 in. with a large excess of air.

It has also been found by experiment that the draft neces-

[1]Journal of Electricity, Power and Gas, March 18, 1911.

sary to burn oil increases rapidly with the rate of overload on boiler. It therefore becomes necessary, in the selection of chimneys for a given plant, to decide both the maximum capacity to which it is desired to be able to momentarily force boilers, and the excess air supply over the most favorable firing conditions, to be regarded as the limit of safety, in everyday practice. The installation of fuel economizers, excessive breeching resistances, etc., will also influence the final result. These considerations determine the draft necessary at the base of the chimney. There is a minimum height of chimney which will produce the desired draft, and should it become necessary to increase the chimney height over and above the necessary minimum, the diameter of the chimney, for economical firing, should be modified to absorb, by chimney and breeching friction, the excess draft thus produced. The provision for a later increase of boilers on a given chimney will, of course, modify these conditions.

There are many factory, pumping, and heating plants, where the load on the boilers in service is practically uniform, and rarely exceeds rating. In certain of these plants, not operated by skillful firemen, it would be possible (building conditions permitting) to materially reduce the chimney height, with an increase in fuel economy.

The writer promises detailed information in this subject, at a later date, and in the meantime recommends to power plant operators a careful investigation of their draft conditions, and possible modifications, to secure improved fuel economy.

The Chairman: In the remarks which Mr. Weymouth has made it has brought to my mind one thought that has occurred to me, namely, that it would be extremely desirable if in all power plants there could be fitted to each boiler a simple, inexpensive instrument which would enable the rate at which the boiler was being fired at any given instant to be determined at a glance. It seems to me that it would lead not only to economy of operation but also to a cessation of abuses and destructive action.

C. R. Weymouth: Answering Mr. Hunt's query, it is possible by controlling the firing of boilers by variation of oil pressure from a central point, all burners being connected to a common oil main, to indicate approximately the rate of load on the individual boilers by pressure gauges connected to the oil to burner branch line.

At the Redondo plant we controlled the firing of boilers from a central point, the individual oil burner regulating valves being wide open or nearly so. The pressure gauge read about 20 pounds when the boilers were fired at rating; about 10 pounds at half load; and about 30 pounds when at 50 per cent overload.

When used in this manner the pressure gauge forms a reliable index for gauging the load on boilers—at least for the purpose of the firemen, and it is about as cheap an instrument as could be secured for the work.

We have with us tonight a non-member—Mr. Dyer—who is engineer of Manufacturing Department of the Union Oil Company. He has intimate knowledge of oil fuel that we could all profit by, if you would call on him for a few remarks.

The Chairman: We will be very glad to hear from Mr. Dyer.

Mr. Dyer: I do not know that I have anything special to communicate, but I have made some notes here of a general character with reference to this subject.

This meeting is being held at the very center of a region probably more dependent, industrially, on the economical combustion of fuel oil than any other region of like extent in the world. Certainly the use of oil for fuel purposes has been of more far-reaching consequence to this coast than to any other part of America. Its use here dates over such a considerable period of years, (the speaker having some familiarity with a plant operating some time in 1885 or 1886), that one would be warranted in assuming that here, of all places, oil burning problems should have most nearly reached their final solution. Many able minds have contributed to the attainment of the highly efficient results sometimes, but not always exhibited here. Some of the best of these minds are represented in this society, and not a few of them at this meeting, either by their owners or their papers, and from personal acquaintance with many of them the speaker feels warranted in expressing the hope that the discussion of this subject will be prolonged through a sufficient number of meetings to allow of their making a contribution of at least 50 per cent of their knowledge instead of the 1 per cent which some of them have parted with through the medium of their contributions. One can scarcely hope to get the full one hundred per cent, as such valuable men have other things to do than write papers, and no matter how generously they may be inclined toward contributing to the education of the engineering public, they are surrounded by obligations which prevent their contributing as freely as they might wish. That much more extensive reservoirs of information on this subject exist locally, than have as yet been tapped is doubtless as well known to all those present as to the speaker. The subject is one in which the mechanical engineers of California should best shine before the world (neglecting consideration of climate at present). It seems, therefore, that you owe it to yourselves, as well as to the rest of the country, to make this series of papers a classic on oil burning. Speaking, therefore, as a visitor, and as one who through connection with the oil industry, is interested in all of the subjects which have been brought up, as well as in others of a kindred nature which will undoubtedly also receive later consideration by your society, the speaker feels warranted in assuming the responsibility in behalf of the outside engineering public to request that sufficient pressure be brought to bear on the possessors of these reservoirs of knowledge to induce them to open up the taps and pay no attention to the meter readings.

These and the following remarks are offered as the contributions of an outsider, safe in the knowledge that the hospitality of his hosts will prevent his being thrown out of the meeting, and in the hope that more extensive contributions to the subject may be brought forth by those of your society who have contributed so much to the success of oil burning. This offering, therefore, will be sketchy in character.

The relation of the heat value of oil to its specific gravity is not commonly appreciated by either the average oil producer or oil consumer. Lack of knowledge of the truth of the relations exhibited in Professor Le Conte's paper, together with a blind adherence to the traditional temperature of 160 deg. F. for fuel oil, coupled with total ignorance of the part which hydrogen plans in the lighter oils, in the economics of combustion, have conspired to create an unwarranted prejudice in favor of light oils for fuel purposes. There is no insurmountable difficulty in handling and burning heavy crude oils at temperatures to the burner ranging from 240 deg. to 350 deg. F. Both the producers and consumers of oil will be benefited by further elaboration of the fact that not only do the heavier oils contain more heat units for a dollar, but within reasonable limits, a greater proportion of available heat units than the lighter. In this connection the Society might render a real service to the general public by straightening out the confusion which exists in the conversion of Beaume degrees to true specific gravity. Although the specific gravity of a 10 per cent salt solution is said to be the basis of the Beaume scale and there should be no great difficulty in determining the gravity of such a solution with reasonable accuracy, there are perhaps some twenty or thirty different formulas for affecting the conversion, none of which has been accepted as authoritative.

The relative heating value of oil and coal is of vital im-

portance both to the producer and consumer. The ratio as it relates to Pocahontas coal is, as far as this Coast is concerned at present, of scarcely more than academic interest. Characteristics of coal commonly available in this market are what interest us all. This information is in existence. The establishment in the minds of the western public of an evaporation of 11 pounds from and at 212 deg. per pound of coal as representing the highest average of a good coal would mislead everyone on the coast who has anything to do with oil. This whole subject is a Pacific Coast subject, and data exist and doubtless can be brought to light by turning the proper tap, to show that while the ratio presented to the last meeting for consideration may be true of eastern conditions, it entirely fails to represent those with which we are most concerned. A ratio of 15.8 to 11.2 gives oil a superiority over coal by somewhat over 40 per cent weight for weight. Mr. Hopps has pointed out that in marine practice a vessel equipped with triple expansion engines from 1000 h.p. up with everything in first class condition would consume about 1¼ lb. of oil per i.h.p. hour. This is probably a fair average, as both better and poorer records are about equally numerous. The speaker had access some two or three years ago to the economical performances of a couple of steamers running on the coast with average coal for an entire year. One of these vessels averaged 2.1 pounds of coal per i.h.p. hour, and the other 2.5. These vessels had triple expansion engines larger than the lower limit of size given by Mr. Hopps. The better record shows about 70 per cent more weight of coal and the poorer 100 per cent more than the 1¼ pound average for oil. These figures are not given in an attempt to prove anything, as some inaccuracy is acknowledged, but it is hoped, will assist in preventing this phase of the subject being dismissed without full justice being done.

With regard to furnace arrangements, both producers and consumers are much indebted to the talent which has developed the efficient types of furnaces now in operation. The debt could be further increased by making their operation as nearly automatic as possible, or failing that, by the development of some system by which the specialized knowledge available can be conveyed with accuracy to the men handling the fires. Speaking for consumers of oil fuel, we would like to see furnaces more liberally provided with peepholes than is usually the case so that all parts of the furnace, and the heating surface exposed in the furnace, and all parts of the fire can be seen at all times. Usually peep-holes are insufficient in number, often incorrectly placed and in many cases entirely missing. Where present they are often of a type which cannot be operated without a hammer, and because of this difficulty never used. It is impossible to tell what is going on physically inside of a furnace without being able to see every part of it within reason. Under full or heavy loads one has little success in looking longitudinally through a 10 ft. flame. Explosion doors, as often provided, are not tight when not in action, and will not close themselves after acting. Sometimes they are so situated that they become overheated, warping to such an extent as to nullify all attempts properly to regulate the air supply. An indicating CO_2 instrument should be a part of the equipment of every boiler furnace in every high grade installation. An instrument, however, which is reliable and obtainable at a price within reach of everybody does not appear to be available. When one is developed it ought to be as much a part of a boiler equipment as a steam gauge. Similarly a draft gauge reading to hundredths of an inch should also be a part of every standard boiler equipment, if any pretense is to be made of securing economical combustion of oil. More care might be given to the placing of burners to avoid possibility of oil, particularly sulphurous oil, lodging on the tubes. Side walls still bulge and center walls still run under load conditions which every boiler should stand, such as, depending on the character of the water, 100 per cent load factor on a thirty day run. A checker-work with variable opening operated by a lever from the front, if such a device could be made practicable would probably be worth while. All dampers ought to be operated from the front and a draft gauge maintained at that point. The floors of furnaces still run and fill up the checker-work, and in many cases the boiler settings still perform the double duty of furnishing economical conditions of combustion and holding up the boiler. Some of these difficulties can be easily rectified, others no doubt will require some time. Meanwhile under test conditions, it may be difficult to improve economical results already obtained, but more attention is required from responsible engineers to make daily operations resemble test conditions more closely.

The stack problem is, of course, intimately associated with that of furnaces, and no doubt everybody wishes it were as simple as we have been asked to believe. If the correct height is 80 to 100 ft. how are we to account for the fact that a boiler plant recently installed by the speaker of 600 h.p. capacity with stacks only 51 ft. above the floor line developed on a five-day test an average of 170 per cent of rating with peaks running up to 200 per cent. Not only this, but the height is such that we still have to keep after the firemen to prevent the admission of an excess of air. Moreover, in the same building a recent storm has entirely destroyed a number of stacks on some return tubular boilers down to the roof line, and there is not the slightest difficulty in running these boilers up to capacity with the stacks in this condition. In this case, the height of stacks cannot be more than about 25 ft. above the floor. If we can get all the overload capacity we want consistent with safety, and the firemen still get an excess of air if not watched, manifestly our 50 ft. stacks are too high. At another of our plants of 1200 h.p. in four units, the stacks are 72 ft. high. These are made higher than would be ordinarily necessary on account of the configuration of the surroundings. With these stacks, the boilers can be operated at any reasonable overload and if the fireman is not watched he will get his CO_2 as low as 2 per cent. These stacks are, therefore, too high, except perhaps under conditions which may bring to bear the adverse influence of the winds passing over the surrounding hills. It is manifestly unsafe to generalize on either the height or diameter of stacks without knowing all of the conditions. No one will deny that the draft resistance in different types of boilers differs; that the amount of overload desired has an influence on the height and area; that the draft resistance in the boiler increases with overload; that conditions which obtain at sea-level are not present at altitude; that the direction of prevailing winds as regards the situation of the plant with reference to the configuration of the surroundings is of consequence; that there is a great difference whether each boiler is equipped with an individual stack, one stack per battery of two, or one stack serving several, with connecting breeching; that every turn in a breeching introduces a draft loss; that the frictional resistance and the cooling effect of economizers must be taken into consideration; that for construction purposes there is an economical ratio of height to diameter; that the price of fuel oil is a consideration, etc., etc. In fact some of us believe that the subject is a complicated one, and worthy of more extensive exploitation.

As to the use of compressed air instead of steam for atomizing, a special occasion for using it in place of steam is probably offered by plants where exhaust steam does not exist in sufficient quantities for heating purposes within the limits of temperature obtainable by steam at or near atmospheric pressure. A plant of 2000 b.h.p. located in Seattle and used entirely for a district steam heating system would seem to present a possibility for this practice.

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Mechanics of Cement Manufacture

The necessity for careful chemical control in the manufacture of Portland cement is exceeded only by the rigid mechanical requirements to produce the requisite uniformity of product. The function of the cement chemist is well understood, but the equally important work of the mechanical engineer is frequently overlooked. Once that the clay and limestone have been mixed, the result is entirely dependent upon thorough calcination and careful grinding, both of which are mechanical problems of considerable magnitude.

Calcination is performed in a rotary kiln which exposes every particle to an intense heat. Variance in mixture requires a corresponding variation in kiln rotation and change in fire conditions. The former is well accomplished with variable speed electric motors which may be momentarily stopped or even reversed, as the occasion may require, and which have a constant power source.

The question of fuel and fire, however, is quite another matter. In the eastern and middle portions of the United States, the use of pulverized coal blown into the kiln by compressed air has been more satisfactorily perfected than has the use of oil in California. This subject has only recently been taken up in a systematic manner by the San Francisco members of the American Society of Mechanical Engineers and there is much to be said and done before standards can be established. In the rotary kiln it is necessary not only to form a spray for complete combustion, but there must be, on account of the simple and unchangeable form of the furnace, a flame which will heat as uniformly as possible almost the entire length of the kiln. Within certain limits the kiln may be dimensionably shaped to accommodate the flame for best results, but this limits both its length and diameter. Where pulverized coal is used, kilns 250 ft. long and 12 ft. in diameter have been successfully used, which have a daily capacity of 3700 bbl.. Such a kiln cannot now be used with oil burning and it remains for refinement of the burner to make this possible.

Tube mill pulverizing is a very delicate operation and there is, for a certain material, a critical speed at which the powder will issue at the proper fineness. The slightest deviation from this speed, unless immediately detected and corrected, may cause trouble throughout the entire process. The mill foreman must therefore keep a strict watch on the frequency meter. Voltage variations are also to be avoided where induction motors are used. Where there is much fine dust in suspension which gets into windings the insulation factor is of more or less importance and the use of high voltage motors has been avoided. This introduces the necessity of heavy service cables and line losses which not only represent a large first cost but a certain maintenance cost from line losses and resultant greater variation in regulation and speed from voltage variation.

It would be possible to more minutely discuss the many other limitations which surround this industry, but the main thing to be shown is the constant care and attention necessary and the co-ordination of all factors to form a salable and perfect product.

PERSONALS.

W. J. G. Lambert, of the Home Telephone Company, recently visited San Francisco.

W. D. Thomas, an electrical supply dealer of Petaluma, was a San Francisco visitor last Monday.

F. H. Poss, San Francisco manager of the Holophane and Benjamin Electric Companies, has returned from Southern California.

J. Barrington, who is connected with the Pacific Telephone & Telegraph Company at Los Angeles, arrived at San Francisco during the past week.

John M. Klein, of Mathias Klein & Son of New York, spent the past week at San Francisco, where his firm is represented by Otis & Squires.

Delos A. Chappell, of the Hydroelectric Company, of Bodie, which is rebuilding its power house in the mountains, has been at the San Francisco office.

A. J. Myers, district manager of the Wagner Electric Manufacturing Company, recently returned to his San Francisco office after a business trip to Arizona.

J. W. Gilkyson, division commercial superintendent of the Pacific Telephone & Telegraph Company, at Los Angeles, was at San Francisco during the past week.

C. G. Roebling, the head of the manufacturing department of John A. Reebling's Sons Company, of Trenton, N. J., left for St. Louis last week, after a visit to his San Francisco branch.

S. J. Lisberger, engineer of electrical distribution with the Pacific Gas & Electric Co., has been transferred to the grade of member in the American Institute of Electrical Engineers.

Hugh McPhee, district commercial superintendent of the Western Union Telegraph Company's third district, has returned to his headquarters at Los Angeles after spending a few days at San Francisco.

C. H. Gaunt, general superintendent of the Pacific Division of the Western Union Telegraph Company, is again at his desk in the San Francisco office after a long illness from which he has fully recovered.

Thomas Mirk, of Hunt, Mirk & Co., returned to San Francisco last Monday from San Diego, where his firm is installing a large turbo-generator and other apparatus for the San Diego Electric Railway Company.

D. P. Robinson and G. O. Muhlfeld, president and manager of construction, respectively, of the Stone & Webster Engineering Corporation, are visiting the Pacific Coast, having spent the past week at Seattle.

K. G. Roebling, general sales manager of John A. Roebling's Sons Company, recently returned from a tour of the Hawaiian Islands, in company with S. V. Mooney, manager of the San Francisco branch, and then left for the East via Seattle.

F. L. Darling has become chief engineer of the Empress Theater building, succeeding C. P. Backus, who has joined the staff of the Lemig & Rapple Engineering Co., 1102 Claus Spreckels building. Darling is one of the "old guard" who used to run on the P. & O. steamers and never surrendered.

W. D. Ward of the Pelton Water Wheel Co. is making a tour of Oregon and Washington. He visited the White River power station of the Pacific Power & Light Co. near The Dalles, Ore. Two Pelton water wheels are already in operation and the company recently closed a contract for a third generating set including a 2100-h.p. Pelton wheel to operate at 514 r.p.m. under an effective head of 137 feet.

Mr. Carl Raymond Gray has resigned as vice-president of the St. Louis & San Francisco Railroad Company to become president of the companies owning and operating the electric lines of the United Railways and the Oregon Electric Railway, Portland, Ore., and the steam lines of the Astoria & Columbia River Railroad, the Oregon Trunk Railway, the Pacific & Eastern Railway and the Spokane & Seattle Railway, with offices at Portland.

PACIFIC COAST MEETING A. I. E. E.

At the Pacific Coast meeting of the American Institute of Electrical Engineers to be held in Los Angeles on April 25, 26, 27 and 28 the following papers will be presented and discussed: "Transmission Applied to Irrigation," by Messrs. O. H. Ensign and J. M. Gaylord; "Cisoidal Oscillations," by Mr. G. A. Campbell; "Continuity of Service in Transmission Systems," by Mr. M. T. Crawford; "New Automatic Telephone Equipment," by Mr. Charles S. Winston; "Auto-Manual Telephone Systems," by Mr. Edward E. Clement; "Some Recent Developments in Railway Telephony," by Mr. Gregory Brown; "Electricity in the Lumber Industry," by Mr. E. J. Barry; "The Refining of Iron and Steel by Induction-Type Furnaces," by Mr. C. F. Elwell; "Transmission Systems from the Operating Standpoint," by Mr. R. J. C. Wood; "A Power Diagram Indicator for High-Tension Circuit," by Prof. Harris J. Ryan.

TRADE NOTES.

The Ideal Electric Company, manufacturers of the Ideal electric vehicle, have changed their firm name to The Ideal Vehicle Company, and have moved into a new factory at 308 East Huron street, Chicago, Ill.

Otis & Squires of 155 New Montgomery street have leased an entire four-story building at 579-581 Howard street and are gradually removing their stock from the various warehouses formerly occupied to the new location. They have taken on the agency for the "Star Products" of the Star Expansion Bolt Company of New York.

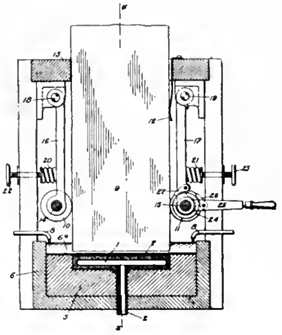
To meet the constantly increasing business around the Pittsburg District, The Richardson-Phenix Company, of Milwaukee, Wis., have recently opened a branch office in the Keystone Building, 324 Fourth avenue, Pittsburg, Pa. This office will be under the management of Mr. H. M. Laughlin, who has been with The Richardson-Phenix Company for several years.

The Fox Company, 1612 Spreckels Building, San Francisco, announce that they are representatives of American Conduit Co., Anchor Bolt & Nut Co., Campbell Electric Co., Chicago Conduit Rod Coupling Co., Clark Electric & Mfg. Co., Colonial Sign & Insulator Co., Osgood, K. L.; Providence Oil Co., and Minneapolis Electric & Construction Co. They also handle automobile accessories, including ignition plugs, tire gauges, jacks, carbureters, etc. Charles L. Turner, formerly with Pierson, Roeding & Co., is now with the Fox Company's sales department.

A. S Kalenborn and A. J. Pahl have opened a shop and office at 37 Stevenson street, San Francisco, and are prepared to handle all kinds of electrical repairing and machine work in connection therewith. They will also buy, sell, rent and install motors of all descriptions, making a specialty of rewinding and repairing high tension transformers. Efficiency tests on hydro-electric plants, electric power meters and tests on any motor-driven installation will be carefully made and they are also prepared to install lead cable work and underground conduit systems and all electrical work in connection therewith. They will further specialize on plans and layouts for isolated plants, pumping plants and general motor applications.

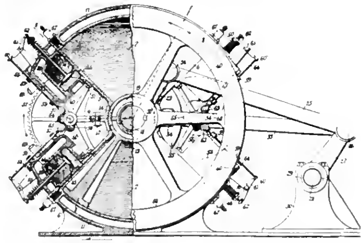
PATENTS

988,316. **Process of Making Ice.** George K. Davol, San Francisco, Cal. The process of forming ice which consists in maintaining a body of liquid mercury at a temperature



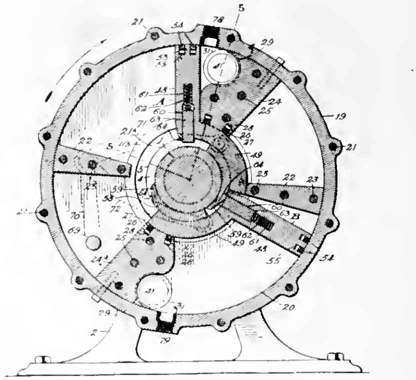
below that at which water freezes, bringing water into direct contact with the said liquid mercury and withdrawing the ice so formed from the mercury.

988,704. **Explosive-Engine.** Charles Ebeneezer Goodrich, Daggett, Cal., assignor of one-half to John H. Sloan, Barstow, Cal. An explosive engine, comprising a driving shaft provided with a crank arm; two hollow sector-shaped explosion chambers disposed radially about said driving shaft and extended in opposite directions therefrom having straight radially disposed end; wall separated to form recesses for valves and mechanism for controlling said valves; two oppositely extended piston blades integrally connected to form a central hub bearing rotatively mounted on said shaft, said piston blades being operatively extended in said explosion chambers and said blades having extended bearing ends disposed in guided relation with the cylindrical walls of said chambers; a radially extended arm fixedly connected with said pistons beyond the confines of said chambers; a crank arm fixedly mounted on said driving shaft; a plurality of pivotally united

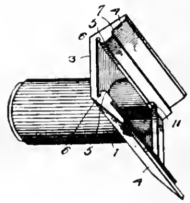


pitmen connecting said crank arm and said radially extended arm; means for guiding the united ends of said pitmen in a straight path; a plurality of valve mechanisms disposed on each of the said end walls of said chambers and having passages through said walls to within said chambers; a plurality of cam shafts mounted in bearings supported on said radial walls, said shafts being extended in parallel relation to the driving shaft; a plurality of cams mounted on said shafts and arranged in quadrated relation, said cams adapted to operate the similar valves in the adjacent valve operating mechanism at intervals of a quarter turn of said shafts; an ignition system embodying four igniters, two of which are mounted in each of said explosion chambers and one of which is disposed adjacent to each of the radial sides in said chambers; and a timing mechanism for operating the said igniters in rotative succession and in a rotary direction the reverse of that imparted to the driving shaft.

988,319. **Rotary Gas-Engine.** Olof F. Edqvist, Denver, Colo. In a rotary gas engine, the combination with a stationary shaft having radially disposed stops thereon, of a cylinder rotatably mounted on said shaft having oppositely positioned partitions, oppositely arranged automatically operating inlet and exhaust valves adjacent to each partition, radially disposed pistons rotatably mounted in said cylinder and adapted to act in conjunction with said partition in confining a volume of explosive mixture, latches in said pistons for engaging the said stops successively and in alternate order, means connected with the pistons whereby when one is locked to the shaft the other is simultaneously unlocked, and arms pivotally connected to the cylinder and to the pistons, whereby the latter are rotated intermittently.



988,777. **Head-Gate.** Perry L. Hedrick, Holtville, Cal. In a structure of the character described, a pipe, a head gate structure formed of concrete in one piece, and having a collar secured to said pipe and lateral flanges and grooves, the lower ends of said grooves being cut away and a metallic gate movable in said grooves and having its lower corners cut away.



988,337. **Battery-Box.** William Henrichs, Moro, Ore. A holder for battery cells, comprising a receptacle; a gauge plate adapted to be secured to the receptacle and having openings to receive the poles of the cells; a lid for the receptacle, adapted to rest upon the gauge plate and comprising rigidly connected upper and lower parts, the lower part having openings alined with those of the gauge plate; pole-engaging springs in the openings of the lower part of the lid; and bars disposed between the parts of the lid, the bars having lugs registering in the openings in the lower part of the lid and engaging the springs to connect the cells.

INDUSTRIAL

WESTON SWITCHBOARD WATTMETERS.

The design of a thoroughly useful wattmeter which will be accurate under all the very varied conditions of general commercial work and remain accurate for an indefinite period of time is an exceedingly complex problem, the complete solution of which has long defied all efforts. The Weston

Fig. 1. Single-Phase Wattmeter.

Electrical Instrument Company's laboratories have for years been working on this problem, and only recently they announced that a satisfactory solution had been reached, and now they are putting on the market a complete line of alternating current switchboard instruments among which is a group of wattmeters.

Fig. 3. Full-Front Polyphase Wattmeter.

These wattmeters employ the same operative principle as the well-known portable Weston wattmeter Model 16, but the construction is of an entirely new type. They are made in two models: Model 167 for direct current and single phase circuits, and Model 216 for two-phase and three-phase circuits. Each model is made regularly in 11 different ranges and any desired range may be had by using suitable instrument transformers.

The external appearance of these meters is shown in Figs. 1 to 3. Fig. 1 shows a Model 167 single-phase wattmeter in the regular full-front case, it is also made with full-flush case.

The general construction and the arrangement of the parts is clearly shown in Figs. 4 and 5. It will be noted that the construction is extremely simple and that all parts are easily accessible. All working parts are mounted on one base which is secured to the back of the case by two stud

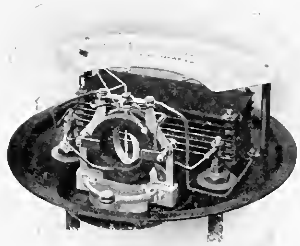


Fig. 4. Interior Single-Phase Wattmeter.

bolts, and the entire movement may be readily taken out without disturbing the connections or removing the instrument from the board.

The field coil supports shown in Figs. 6 and 7 are made of a special high-strength, high-resistivity alloy and are rolled to gauge so as to establish and maintain accurate alignment of the field coils. The arc-shaped flanges, secured to the supports by metal eyelets, serve to center the field coils about the same axis. By virtue of this method of precisely locating the coils and by properly choosing the relative proportions of the field and movable coils, every wattmeter in this group has been given a uniform or proportional scale. The attainment of a uniform scale characteristic is a great achievement, since it has been generally believed that a non-uniform and purely empirical scale was inherent to this type of instrument. A uniform scale is of great value in switchboard work, since it permits the making of approximate readings from a distance based upon the general position of the pointer with reference to the scale as a whole.

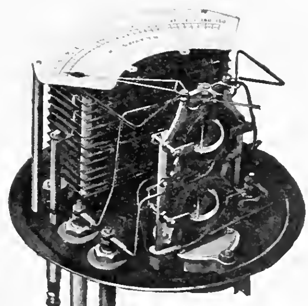


Fig. 5. Interior Polyphase Wattmeter.

Eddy currents in the metallic masses of the instrument have always been an exceedingly troublesome source of error in wattmeters for use on alternating current circuits, and although they may be compensated for some chosen set of working conditions, such as frequency, power-factor, etc., the only way to avoid this error is to eliminate the eddy currents themselves. By the use of special alloys and by scien-

tific design, eddy currents in the working parts of these wattmeters have been practically eliminated. How complete this elimination is, may be judged from the fact that

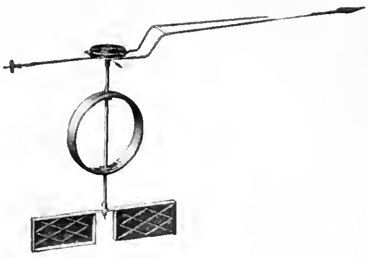


Fig. 6. Movable System Single-Phase Wattmeter.

these wattmeters can be used on frequencies as high as 1000 cycles per second without increasing the total error to much over 1 per cent even at power factors as low as 0.50.

In connection with the development of these wattmeters, the damping problem, which is common to all forms of indicating instruments, has also been solved, and the damper produced as a result of this investigation work is now used in all the Weston alternating current switchboard and soft-iron instruments. It consists of two very light vanes symmetrically mounted about the axis so as to require no counterbalancing. These very thin metal vanes are strengthened without increasing their weight, by stamping ribs into the sides and by bending over the edges (Fig. 8). Each vane fits closely in a fan-shaped chamber cast in one piece with the base and closed by a tight-fitting cover. The only opening to the outside is a very small arc-shaped space left to allow the free motion of the arm which carries the vane.

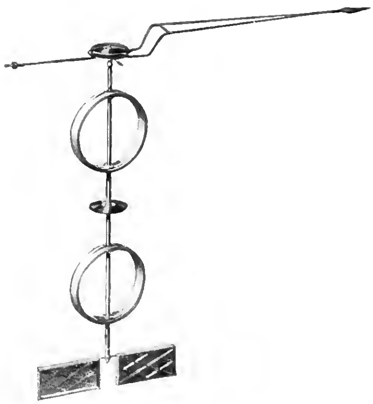


Fig. 7. Movable System Polyphase Wattmeter.

By this new form of construction the useless leakage to and from the outside of the chamber is for the first time reduced to a negligible quantity and thus the compression of air on the advancing side of the vane and the rarefaction of air on the receding side is enormously increased and therewith the efficiency of the damper is correspondingly increased. The effectiveness of this damper is further augmented due to the low moment of inertia of the vanes which are extremely light and are placed as near as possible to the axis of rotation.

Another important detail of instrument design which seems to have been worked out in the course of the development of these wattmeters is a pointer which is especially well adapted for use in alternating current instruments. The problem is to construct a pointer which shall be light and strong and have a natural frequency outside the range of

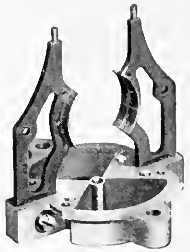


Fig. 8. Base and Coil Supports Single-Phase Wattmeter.

commercial frequencies so that the same pointer can be used for all commercial frequencies and yet have a low moment of inertia and add but little to the load on the pivots.

The Weston wattmeters, as well as all other Weston alternating current switchboard instruments, are equipped with this new type of pointer, which is made in the form of a triangular truss with tubular members and is fitted with a very thin index tip stiffened by a rib which is stamped into the metal and follows the contour. They are free from resonant vibration within the ordinary commercial limits of frequency. Tests from 15 to 900 cycles per second fail to show the slightest trace of vibration at any commercial frequency between these limits.

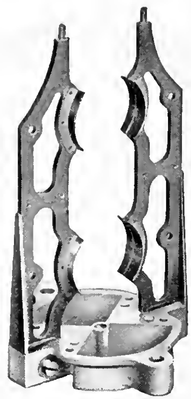


Fig. 9. Base and Coil Supports for Polyphase Wattmeter.

An innovation which should be welcomed by the user is a device provided for the adjustment to zero of the pointer from the outside of the case. By means of this device the zero position of the pointer can be adjusted with a screw driver from the front of the case without removing the instrument from the board or disturbing the connections.

The accuracy under all the very varied conditions of practical work is unusually great, which might well be expected as a result of the general excellence of the design and construction. The accuracy is guaranteed within 1 per cent for changes in temperature from 50 deg. Fahr. below and 50 deg. above the normal temperature, for variations in frequency from 15 to 900 cycles per second; for fluctuations in power-factor from 0.50 lag to 0.50 lead, and for distortion of wave form such as may occur on ordinary commercial circuits.

NEWS NOTES

INCORPORATIONS.

RIVERSIDE, CAL.—The Mississinewa Water Company has been incorporated by W. D. Lewis, Edith B. Lewis, and L. B. Scranton, with a capital stock of $10,000.

SAN BERNARDINO, CAL.—D. R. Paramore has incorporated the Union Power Company to operate in San Bernardino, Riverside, Orange and Los Angeles counties.

REDWOOD CITY, CAL.—The Redwood City Railway Company has been incorporated by Geo. A. Merrill, Geo. W. Lovie, V. V Greco, W. J. Drew and C. F. Morrison, with a capital stock of $125,000.

SAN FRANCISCO, CAL.—The West Coast Power Company has been incorporated by S. E. Bretherton, H. P. Anervalt, I. J. Bradberg, M. F. Vandall and G. O. Perry, with a capital stock of $500,000.

LOS ANGELES, CAL.—The Frost Gas Producer Company has been incorporated by Lyman Stewart, H. O. Melveny, W. M. Garland, W. W. Mills, F. T. Riffle, Arthur L. Adams and Warren H. Frost, with a capital stock of $900,000.

TRANSMISSION.

ELGIN, ORE.—The McCally-Rumble Land & Power Company has been granted a power franchise in this city.

AUBURN, CAL.—The Great Western Power Company has been granted a franchise in this city. The company has also been granted a permit to erect a pole line along the Rocklin-Folsom road.

ALAMEDA, CAL.—The City Council has appropriated $3000 for the installation of a power line to supply current for operating the turning motors on the three drawbridges across the tidal canal.

VALLEJO, CAL.—E. F. Crowley, a San Francisco contractor who has the job of erecting the new power station at Mare Island, will start active construction of the $100,000 building on or about the first of next week.

CULVER, ORE.—Prineville men, composing the Cove Power Company, have begun the construction of a power plant on Crooked River, about two miles and a half west of this city. The firm of Brown & Van Valkenburg of Culver has a contract for a large amount of work.

BROWNSVILLE, ORE.—The Oregon Power Company, which has been negotiating for the purchase of the local electric light and power plant, owned by the Brownsville Electric Light Company, has closed the deal and is in possession. The company proposes to rebuild the system throughout the city.

TRANSPORTATION.

HONOLULU, H. I.—The Honolulu Rapid Transit and Land Company has declared a quarterly dividend of 1½ per cent on common stock.

MODESTO, CAL.—The final ordinance closing the sale of the franchise on Eighth street to the San Joaquin Valley Electric Railroad Company, has been passed.

WHITE SALMON, WASH.—It is reported that the Pacific Power & Light Company is securing a right of way from the mouth of the White Salmon River to Trout lake, a distance of 30 miles, for the construction of an electric railway. Much property along the proposed route has been taken over by the company.

PORTLAND, ORE.—General Manager J. P. O'Brien of the Harriman lines in Oregon, announces that the Jefferson street line, or Yamhill division of the Southern Pacific, will be electrified along with the Fourth street line.

CALISTOGA, CAL.—O. W. Mielenz, manager of the Napa Valley Electric Light & Power Company, was in town last week looking over the field preparatory to extending the company's line from St. Helena to Calistoga.

CORVALLIS, ORE.—The City Council has received a franchise granting the Albany Interurban Railway Company the use of certain streets throughout the city, over which will be constructed power transmission lines.

MERCED, CAL.—A. G. Elliott, representing San Francisco capital, is here for a few days in the interest of the Tidewater & Southern Railway, now completing an electric road from Stockton to Modesto. The company is now making arrangements to have its road built on to Merced, figuring on the latter point as its natural terminus.

SAN FRANCISCO, CAL.—The conference called last week to discuss questions relative to the Geary street municipal street railroad decided that immediate construction work should be commenced on the roadbed and the overhead lines. The former is to be done by contract and the latter by the Board of Public Works. It has been decided to do the work by contract rather than day labor.

OAKLAND, CAL.—The Oakland & Bay Shore Railway Company, allied with the Oakland and Antioch Railway Company, has filed an application with the City Council asking for a 50-year franchise on Shafter avenue at Fortieth street and along Shafter avenue to 800 feet beyond Kieth avenue. This line will form the connecting link between Oakland and Antioch, which comes into the city over a private right of way, and the Key Route.

SAN FRANCISCO, CAL.—The Southern Pacific Company has purchased all of the electric street railroads in San Jose and Santa Clara from Lewis F. Hanchett. The consideration is said to be $4,000,000. The purchase is made in the name of the Peninsula Railroad Company, an adjunct of the Southern Pacific Company, which is incorporated to build a system of electric lines from San Jose north by the way of Menlo Park, Palo Alto and San Mateo into San Francisco.

SAN FRANCISCO, CAL.—The prospect for the United Railroads immediately getting the permit it has asked for, to put down a curve connection between the tracks at Presidio avenue and California street, is not good, and the present indications are that the company will have first to recede from its refusal to run the Sutter street electric cars down the inner tracks on Market street to the ferries. This was the ultimatum put forth at the last meeting of the Board of Supervisors.

JACKSON, CAL.—C. P. Vicini of Jackson, former district attorney of Amador County, appeared before the Board of Supervisors this week and stated that at the May meeting of the board he and his associates will present a petition for a franchise for an electric railroad across Amador County, to connect Jackson and other towns of the county with Sacramento or Stockton. Associated with him in the proposition are Julius Chichizola, an Amador City merchant; V. Brignola, and C. E. Jarvis of Sutter Creek.

VALLEJO, CAL.—The Vallejo & Northern Railroad Company has filed papers showing the recent action of the board of directors in increasing the capital stock of the company

from $2,500,000 to $10,000,000, divided into 100,000 shares of a par value of $100 each. With this increased capital stock, the company plans to extend its system through the northern valley and to add to its equipment for the southern line when completed, bringing Vallejo in direct touch with the largest interests in the northern section of the State. The company will establish offices at Suisun and these offices will be in charge of T. T. C. Gregory, president of the road, and William Pierce, secretary.

ILLUMINATION.

KLAMATH FALLS, ORE.—The Council has granted to the Klamath Falls Light & Water Company a franchise to furnish light and power in this city.

ROSEBURG, ORE. W. F. Boardman & Co., of San Francisco, have applied for a 50-year franchise to lay gas mains on all streets and alleys in this city.

KAMIAH, IDAHO.—The Council has granted the Nez Perce Water & Power Company, of which Z. A. Johnson, is president, an electric lighting franchise in this town.

DAYTON., WASH.—The Council has passed an ordinance granting a franchise to the Dayton Electric Company to construct and operate electric light and power lines in the city.

LA CROSSE, WASH.—M. W. Feckler of Winona has purchased eight acres one mile west of Winona and will erect a power house. He expects to supply light and power to Endicott, Winona and La Crosse.

CHEHALIS, WASH.—With the passage of a franchise granting the Twin City Light & Traction Company a lease to operate an electric lighting plant here, arrangements have been completed for the erection of a $75,000 power house.

YREKA, CAL.—The Siskiyou Electric Power & Light Company has begun work on the construction of a dam at the head of Ward's Canyon, sixteen miles above Hornbrook, on the Klamath River. The dam will be 250 feet long and 90 feet high.

ELLENSBURG, WASH. E. L. Butler, superintendent of the electric light department, states that a dredger will be installed in the power ditch for the municipal light plant. The channel will be enlarged and when completed 2000 electric horsepower will be generated.

PORTLAND, ORE.—Work on the power site of the Valley Development Company at the headwaters of the Cowlitz River, will be started as soon as the snow in the moutains melts. A large reservoir is to be constructed. It is estimated that the site will have a possibility of developing 125,000 h.p. and machinery for that capacity will eventually be installed.

WASHINGTON, D. C.—Bids will be received at the bureau of yards and docks up to April 29, for one 3000 cubic feet air compressor, with intercooler, aftercooler and air receiver for the central power plant U. S. Naval Station, Pearl Harbor, Hawaii. Bids will be received at the same time and place for six 450 h.p. water tube boilers, equipped with oil burning apparatus, etc., for the same power plant.

PORTERVILLE, CAL.—The Home Gas Company has just completed the renovation of its plant. Additions have been made which will make it possible to supply from the plant here gas to the immediately surrounding towns. Preparations for this are now being made. A compressor and compressor tank have been added and this city has been divided into four districts. Gas will be furnished under pressure of about ten ounces to the various districts, where automatic regulators will step it down to the four ounce pressure at which it is ordinarily used. It is planned to start shortly upon high pressure lines to supply the gas to Terra Bella and Ducor, and it is probable that it will shortly be also supplied to Strathmore.

SACRAMENTO, CAL.—To insure a reserve plant in case of emergency and have an auxiliary to their Sacramento system the Pacific Gas & Electric Company is making arments to install a steam power plant in this city, for the manufacture of electric current. The site has been selected, and the plans are being drawn. It is understood that the plant will be located on the north side of the city, not far from the Southern Pacific Railroad shops, and in the neighborhood of the Pioneer Mills.

WHITTIER, CAL.—The Southern Counties Gas Company has taken over the gas properties of Southern California as follows: The Edison Company at Whittier and Santa Ana; Orange County Gas Company, serving Orange, Anaheim and Fullerton. The company will be financed with the co-operation of J. H. Adams & Co., of Los Angleles and by local stockholders of the different companies absorbed. The officers are: President, C. S. S. Forney of Los Angeles, president of the Covina Valley Gas Company and Piedmont Gas Company; first vice-president and treasurer, F. M. Bain of Fullerton; general manager, W. A. White of Santa Ana; directors—F. E. Miller of Anaheim, John Badger of Whittier and C. H. Ainley of Monrovia. The company will run a high-pressure line from the Santa Ana plant northward, taking in Anaheim, Orange and Fullerton. Later, a main will be extended north to Monrovia and east through Covina, Glendora and Azusa. The company is capitalized at $1,000,000.

WATERWORKS.

MADERA, CAL.—F. C. Roberts is here making preparations for the installation of the new water-works.

PLEASANTON, CAL.—A 50 h.p. motor and a pump capable of pumping 30,000 gallons of water an hour into the town reservoirs, has been purchased by the trustees of Pleasanton.

SUSANVILLE, CAL.—Plans are now being made for a substantial enlargement of the facilities of the Susanville Water Company.

SAN FRANCISCO, CAL.—The Sierra Blue Lakes Water & Power Company, through its president, has submitted to the Mayor and the committee for the consideration of the purchase of the Spring Valley Water Company two new propositions relative to the holdings of the Blue Lakes Company. One proposition contemplates the duplication of the Spring Valley plant, with double capacity, taking city bonds in payment therefor. The second offers to sell to the city the property of the company at the price on file with the Board of Supervisors, or to leave the price to the judgment of a committee or board selected by the Supervisors, its decision to be final.

GRASS VALLEY, CAL.—A movement is on foot for another large water system for Nevada and Placer Counties which it is claimed will be the equal of the South Yuba Water Company. According to documents just filed, James D. Stewart, of Gold Run, Placer County, has leased from the United Water & Power Company certain water and mining claims for a period of 20 years, and he has secured an option on 240,000 shares of the company's stock at $75,000. Besides leasing the company's property in Placer and Nevada Counties, Mr. Stewart has filed on five water rights, amounting in all to 355,000 inches of water. It is generally believed that Mr. Stewart represents a big corporation. The property will be developed, the intention being to build another water system in Placer County equal to that of the South Yuba Water Company. The new company will make it possible for thousands of acres of land, which cannot now be used on account of lack of water for irrigation purposes to be opened to settlers and the population of the county greatly increased. Besides this, valuable mining claims will be developed, and electricity will be generated from many power sites now under control of Mr. Stewart.

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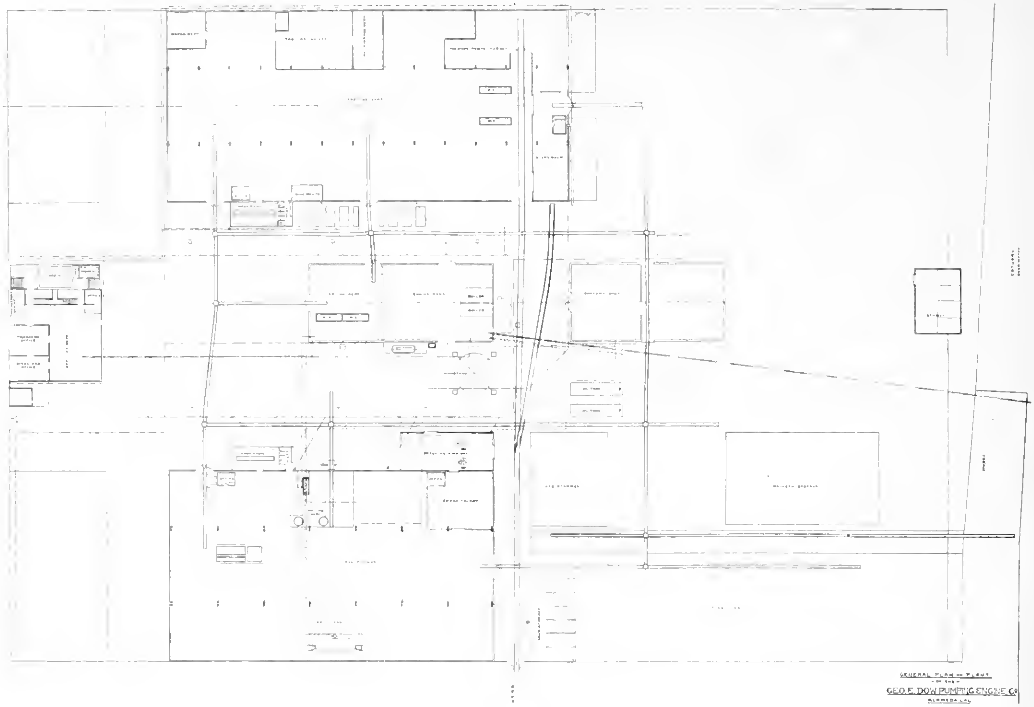
MOTOR DRIVE IN THE DOW PUMP WORKS

BY J. W. SWAREN

Among the noteworthy industrial works about San Francisco is the power plant installed for supplying light, heat and power to The Geo. E. Dow Pumping Engine Co. These shops are housed in well constructed corrugated iron buildings on the banks of the Alameda estuary, and have deep water and rail shipping facilities.

Engine, Generator and Switchboard Supplying Power for the Dow Pump Works.

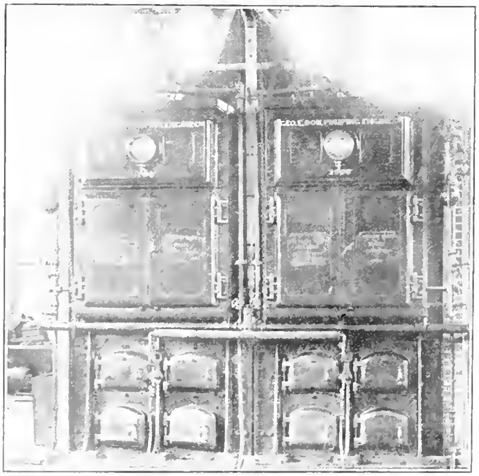
When the erection of new shops was under consideration, electric drive was adopted as the most modern method, but the question of buying power or generating it in an isolated plant was opened to the management. Alameda is served by a municipal plant, and no competition in the sale of electricity is permitted. The rates offered for loads similar in character to the load of a general machine shop did not seem attractive when compared with the possibilities



Plan of Works.

of power generated in their own plant. This was particularly true as steam for testing purposes would be needed under any arrangement. The judgment of the engineers responsible for this plant has been sustained in practice.

The power house, a building 50x120 ft., is placed

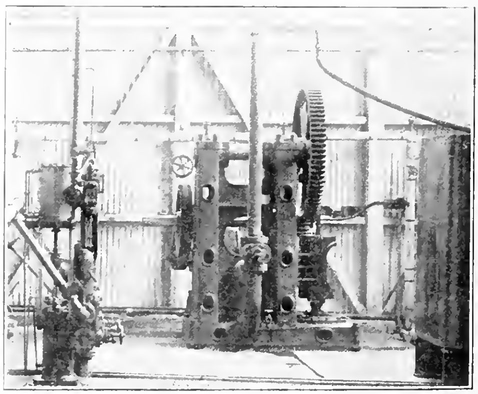


Boilers

near the geometrical center of the factory, and as the machine shop is on one side, foundry at the other, with office and pattern shop at the ends and testing room under the same roof, the load center is practically co-incident with the geometrical center.

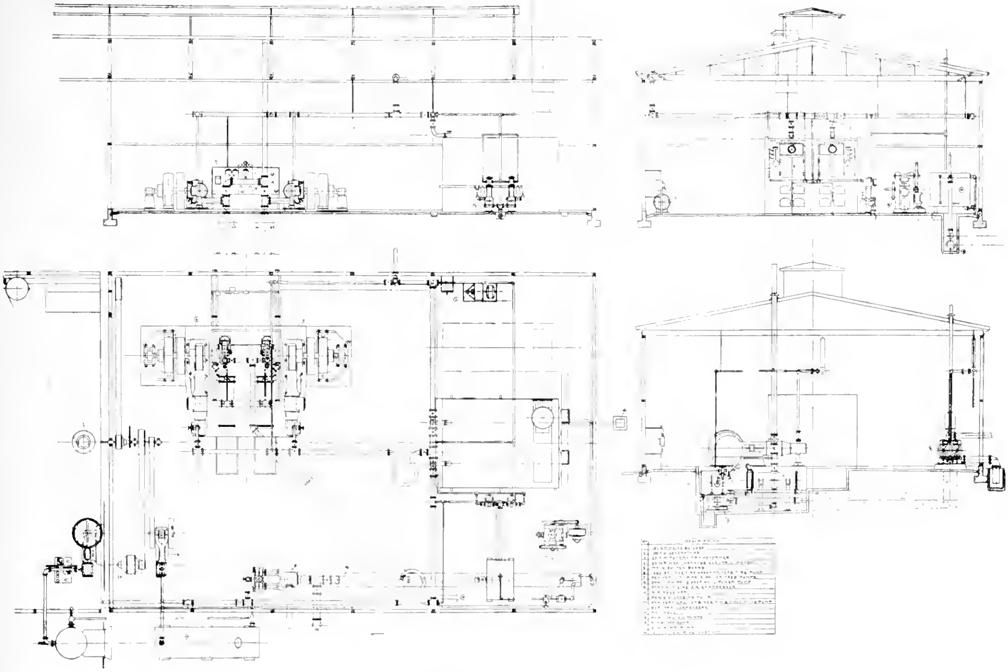
The engine room, which contains all pumps and boilers as well, is 50x70 ft., with concrete floors. Two Heine safety water tube boilers, rated at 100 h.p. each are installed. They have 65 tubes 3½ in. diameter and 16 ft. long, and steam drums 36 in. diameter 18¾ ft. long. Saturated steam, at a pressure of 150 lb. is delivered.

Crude oil is used for fuel and is stored in two



Oil Pumps, Filter Tank and Artesian Well Engine.

tanks, each with a capacity of 12,560 gallons, set on concrete piers outside, and 40 ft. from the building. The oil flows by gravity to the oil set. It is received



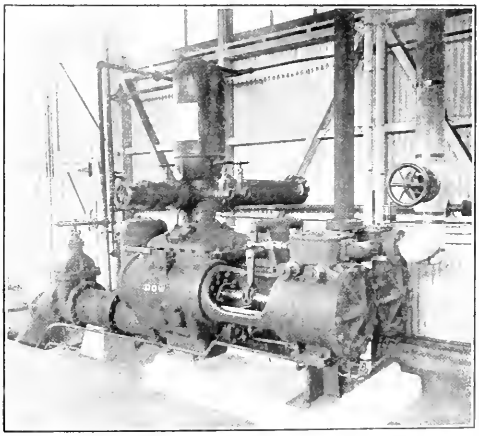
General Plan of Power House.

in tank cars and a Dow oil fitted 6x6x6 in. duplex pump is used for unloading. The oil burning system consists of a standard Staples and Pfieffer set equipped with two Dow 4½x2¾x4 in. oil fitted duplex pumps. The quantity of oil consumed is metered. The meter is connected between the pumps and heater, thus measuring the oil cold.

The auxiliaries exhaust into a filter box which serves as a hot well, receiving the condensed water from the engine condensers. Feed water, at a temperature of 150 degrees F. is taken from the hot well by two Dow marine type vertical single piston feed pumps, 6½x4¼x10 in. These pumps are fitted with removable bronze lined cylinders, bronze pistons and bronze valves, and the steam and water connections are made to manifolds, permitting of the fullest flexibility in handling.

The main water supply comes from a bored well, having a diameter of 14 in. and 200 ft. deep, drilled under the engine room floor, near the boilers. A Dow power driven artesian well engine, with an 18 in. stroke operates a Dow bucket plunger pattern deep well cylinder, with 7⅜ in. bucket, and 5½ in. plunger, placed 190 ft. below the floor. Water at the rate of 80 gallons per minute is delivered by this pump to a tank 115 ft. above the ground level. This tank has a capacity of 30,000 gallons, and is supported on a structural steel tower. The base of this tower is 30x30 ft. and the corner posts rest on concrete piers, 4x4 at the top and 8x8 at the base, and sunk 8 ft. in the ground.

The deep well pump is motor driven through a silent chain drive. A 13 h.p. Westinghouse motor, controlled by an automatic starter operated by a float switch in the tank, is mounted on a special sub-base. The sub-base of the motor and the base of the pump are connected by a distance piece made from a piece of 6 in. extra heavy pipe, 10 in. long, with flanges on both ends. These flanges, are in turn bolted to the respective bases, the whole forming a compact, inexpensive and rigid subbase of sufficient size to accommodate the silent chain.

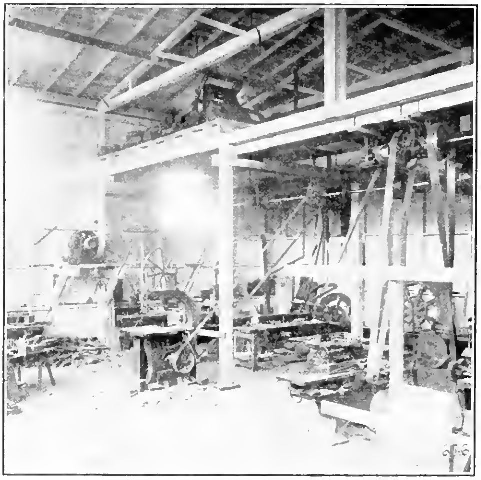


Fire Pump.

A cast iron pipe, 14 in. in diameter, with lead caulked joints runs from the engine room to the estuary, 320 ft. away. This supplies salt water for condensing purposes and fire protection.

A Dow standard underwriters' duplex steam pump, 18x10x12 in. with a capacity of 1000 gallons per minute at 70 r.p.m. is connected directly to the end of the salt water line. A Y branch in this line, just in front of the fire pump connection, provides for condenser connections. The fire pump is connected to a system of piping extending about the building and numerous hydrants and hose reels are provided.

To supply compressed air for use in the shops a Dow straight line radial valve compressor is installed in the engine room. It delivers 400 cu. ft. per minute at a pressure of 80 lb. per sq. in. into a receiver 54 in. x 16 ft. set outside the building. An automatic unloader controls the compressor, which is driven by a 40 h.p. motor belted to a jackshaft. The starting resistance of this motor is of the open grid type and is mounted on the engine room wall. The jackshaft projects through the partition between engine room and testing room providing a means for driving centrifugal pumps during test.



General View of Pattern Shop.

The boilers are connected to a steam header from which the steam is distributed by three lines, one 6 in. line leading to the testing room immediately adjacent to the engine room; a 6 in. line is carried over the engine to which it is connected by a long radius bend; and the third line leads to the machine shop erecting floor, where it supplies steam for testing machinery too heavy for test in the regular testing room. The line leading to the engine is terminated by a blank flange, a provision for a future unit for which foundations are already built. The fire pump is connected to the testing room line.

Flanged fittings are used throughout, corrugated copper gaskets being installed. Up to the present time no trouble has been experienced with these gaskets. All piping is covered with 85 per cent magnesia one inch thick.

To provide for expansion and contraction in the piping system copper, U shaped expansion joints are installed on the testing room and engine lines, while roller hangers are used throughout.

A Swartout vertical separator is installed just above the throttle and effectually removes all condensation.

A Ball tandem compound engine, 10x18x16 in., running at 250 r.p.m. is direct connected to a 100 kw. 250 volt, Westinghouse generator. The engine is of the semi-enclosed type, with Sweet valve gear and standard Ball inertia governor. A combination splash and gravity oiling system is used; a pump in the crank pit lifting oil to a tank above the engine to be carried by gravity to main bearings and back into the crank pit.

The high and low pressure cylinders are lubricated by standard condensation type lubricators, cylinder oil having a flash test of 600 degrees F. being used. Metallic self lubricating packing is used in piston rod and valve stem glands.

Between the two engine foundations a condenser pit is sunk. At present only one condenser, a Dow surface type, is installed, room for a duplicate unit being provided. This condenser has brass U tubes, with a total area of 400 sq. ft. A niche is cut in the engine room floor so that the tubes can be readily withdrawn. Salt water at an average temperature of 70 degrees F. is drawn from the fire line, and a vacuum of 26 in. with barometer reading 30 in. is readily maintained when condensing 1900 lb. of steam per hour.

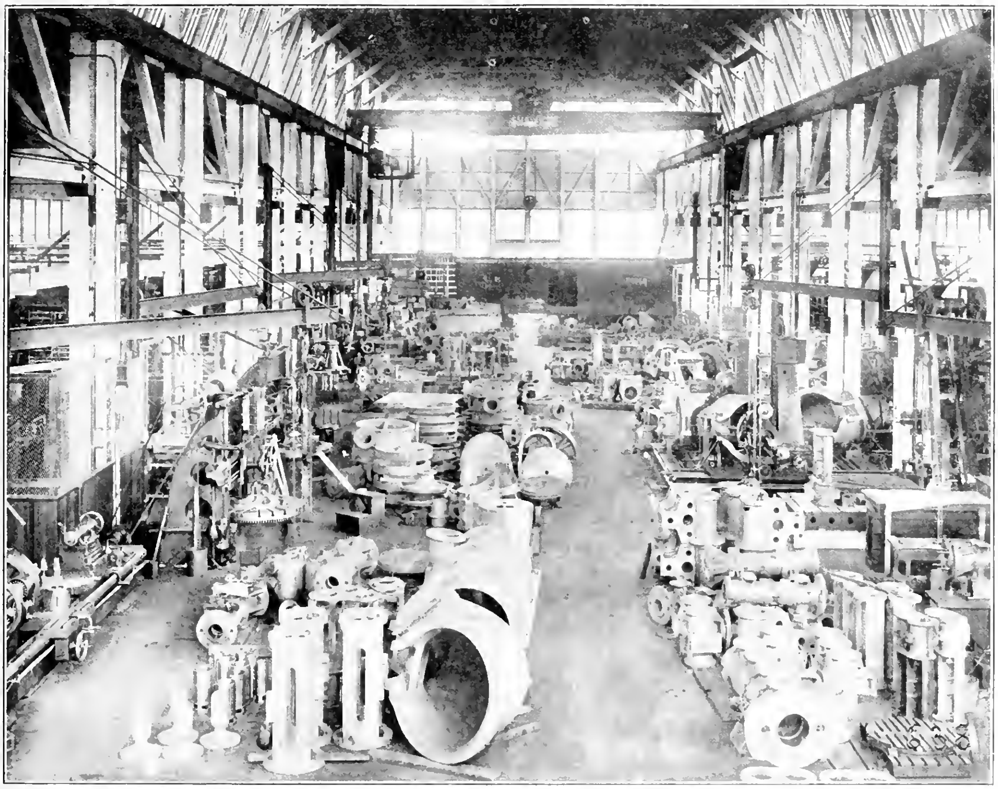
General View of Foundry.

A Dow twin vertical combined air and circulating pump is installed. This pump has a steam cylinder 8 in. diameter, air cylinder 12 in. diameter, circulating cylinder 8 in. diameter, with a 10 in. stroke.

To handle sumpage, a Dow duplex pump, 3x2x3 in. exhausting into the main condenser, is mounted on a bracket fastened to the condenser pit wall.

The generator is the standard direct current engine type mounted on separate subbase, with outboard pedestal bearing. The main leads are carried in conduit under the floor to the switchboard.

The switchboard has five panels of black slate. The first panel is intended for a future unit, but at present is utilized for a meter panel, carrying a 600 amp. 221-250 volt G. E. astatic type watthour meter. The second panel is used as a generator panel for the present unit, having a three-pole switch for main and equalizer leads, automatic circuit breaker, voltmeter, voltmeter plugs, pilot lamp and ammeter. The



General View of Machine Shop.

third panel is used for controlling the motor-generator and city service. It has the necessary switches for controlling the generator of the motor-generator, and two d.p.d.t. switches for throwing the office lights from the main bus bars to the city service. The fourth panel is used as a power and lighting distribution panel, controlling the lights for foundry, and machine shop, motors for foundry, foundry blower, pattern shop and engine room. None of these circuits are equipped with automatic circuit breakers. The fifth panel is also used as a distribution panel. It has a switch controlling the machine shop motor circuit, and automatic circuit breakers on the circuits supplying foundry crane and machine shop crane, and a third breaker on the leads from the generator of the motor generator set.

As a provision for overtime work in offices and shops, standby service is purchased from the Alameda municipal lines. The distribution on these lines being two-phase sixty cycle alternating current at 220 volts, a motor generator set is required. A standard Westinghouse 25 h.p., 220 volt, two-phase CCL motor, running 1120 r.p.m. is direct connected on the same bedplate to a Westinghouse 20 kw., 250 volt direct current generator. The auto transformer and motor control switches are mounted on a pipe frame, slate panel, board near the motor generator set.

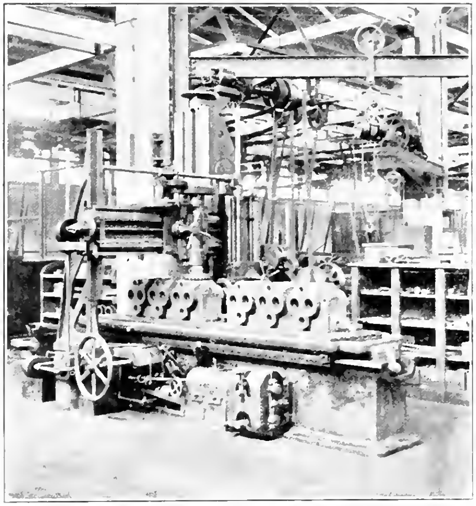
The economy obtained in this plant is quite good when all the factors governing it are taken into consideration. Daily performance shows 85 kw. hrs. per bbl. of oil, while the load factor is only 45 per cent measured against a nine-hour day. This is equivalent at a load factor of 17 per cent measured against a 24-hour day. Large excess capacity, both in engines and boilers, is required for testing purposes, although under normal conditions fires are maintained under one boiler only.

The machine shop building is arranged in three bays, the middle bay being covered by a monitor roof, and spanned by a ten-ton high speed Shaw crane. Light machine and tool work is done in the side bays, the heavy machine tools being arranged along the sides of the main bay so as to be served by the crane. The erecting floor is in this bay as well.

Both the group and individual systems of machine drive are in use. The individual drives are generally equipped with variable speed motors, and in some instances as many as three motors are used on one machine. Where the group system of driving is employed, the motors are mounted on a bracket designed and made in the shops.

In the foundry the moulding floor is spanned by two ten-ton cranes, with a bridge of 48 ft. The moulding machines are pneumatically operated, while tumbling barrels and other machinery are driven on the group plan. For serving the charging floor of the

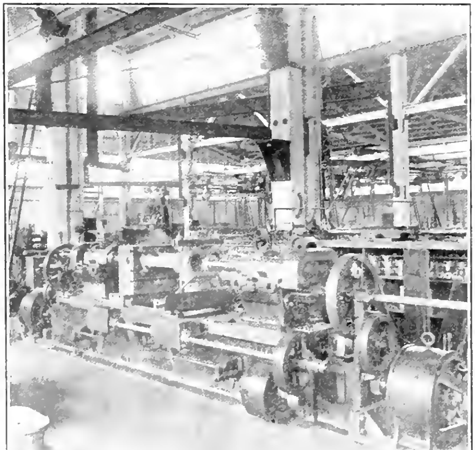
cupolas a 4000 lb. pneumatic elevator is installed outside the building. A reducing valve is installed on the testing room line to supply steam to the indirect system of heating installed in the office building. The heating coils and blowers are installed in the basement of this building.



Motor Driven Milling Machine, Showing Post Bracket Motor Mounting in Back Ground.

Tungsten lamps are installed in the machine shop and foundry, while carbon lamps are used in office and engine room.

Of more than passing interest to engineers is the drafting room on the first floor of the office building. It is situated on the north side of the building, and



Three Motors on Machine No. 122.

one large sheet of glass forms the north wall. This gives an excellent diffused light throughout the room, which has tables accommodating 12 men. On the second floor a complete blue printing room is fitted with every convenience, including a Cooper-Hewitt electric blue printing machine, sun frames and washing conveniences.

The entire plant was designed and erection supervised by Mr. W. H. Dow, works manager, to whom the writer is indebted for the information contained in this article. The tests from which the data regarding operation were taken, were made, by Mr. R. F. Chevalier, consulting engineer for operation.

RECLAMATION OF THE ARID WEST.[1]

BY FREDERICK H. NEWELL.[2]

The benefits derived by applying science to industry and the still greater benefits that may be expected when all great problems are attacked in the scientific spirit and on the scientific methods are to a certain extent exemplified by the opportunities afforded and results now accomplished in the conservation of the natural resources of the Nation.

The reclamation of the arid West is simply one of a number of items of national importance upon whose correct solution by true scientific methods rests largely, not merely the material prosperity of the Nation, but, more than this, the perpetuation of free government, and of high standards in individual liberty.

The stability of a republic or democracy, whichever we may term it, rests not upon its wealth, but upon the character of the individual citizen and voter. The greatest commonwealths are not necessarily those having the greatest natural resources, but rather those in which the human units are strong. The strength of the unit, the family or the voter, is not derived from material wealth, but from ability to act and think independently and to exercise that intelligent self-interest which binds him to the great mass of his fellow men. If, for example, he is working in a factory or on a railroad line, he is, of course, interested in keeping his job. Beyond this, he has little concern with the condition of municipal, State or Federal affairs. These are entirely too remote to touch him, and if he lives in a tenement, he has no concern beyond paying his rent and getting the most he can for it.

But take this man, indifferent to forms or details of government, and put him upon a 40-acre farm. Assuming that he has reasonable industry and intelligence, his whole view point of life changes. He is transformed from being more or less of a nomad, shifting from flat to flat, or from town to town, and indifferent to the general welfare. He now becomes a landowning citizen and voter, interested in every public movement for better roads, better schools, better local government, and everything which leads up to the stability of the institutions of the State as upon these rest the value and comfort of his home.

This thought has been most pithily embodied in a statement attributed to Edward Everett Hale where he asks "whoever heard of a man shouldering his musket to fight for his boarding house?"

The problem of the reclamation of the arid west is being attacked primarily for the purpose, not of mak-

[1]Presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

[2]Director, U. S. Reclamation Service, Washington, D. C.

ing men rich, but of strengthening the foundations of the State. It is an attempt being made by the Federal Government almost at the eleventh hour of its opportunities to utilize the waste resources still remaining at its command, and to employ these in such a way as to strengthen local communities and states, and to create in the more remote parts of the country many prosperous communities composed of independent, landowning citizens, each family being resident upon a farm sufficient for its support, and cultivating the soil intensively, under favorable conditions of sunlight and of water supply, such as to produce the largest crop yield per acre, and to bring about the largest individual success.

The people thus placed upon the farms are not merely producers. They not only raise enough to support themselves, and to sell to their neighbors, but indirectly they stimulate all industries. They are large consumers, as well as producers, and it may be said that for every family placed upon an irrigated farm on the desert, there arises the possibility of another family engaged in transportation or in manufacturing in the East or Middle West. All parts of the country are thus linked together. The success of the irrigator in the West means larger cotton production in the South, more boots made in Massachusetts, more freight and passenger cars hauled across the continent.

The success already attained in applying scientific methods to this great problem of conservation of the waste resources of the country may be attributable in part at least to the Institute of Technology, and to the instruction there given.

With a comprehensive and reasonably accurate review of the conditions to be met, it is then possible to bring to the solution of the problem the principles and methods of engineering and to put into play the constructive ideas which are inseparable with a technologic education.

The constructive faculty, the ability to imagine or to picture desirable results, and to turn these into accomplishment by scientific methods is the foundation for success in these larger lines of work.

In the matter under consideration Congress in 1888 authorized an investigation of the extent to which the arid lands might be reclaimed. This problem is enormous and its correct solution is fundamental to the future growth and development of the Nation, because of the fact that one-third of its area is arid. In that third are potentially some of the most valuable lands in the world.

The problem is to obtain water for these lands. This in turn rests upon questions of economics and engineering, in storage of flood or other waste waters, and in the adjustment of a form of agriculture suited to these conditions. The results already attained show that the lands are not only capable of supporting a large population, but under Government auspices many thousands of families have been settled in prosperous homes and a highly desirable class of citizenship has been created in a most sparsely populated part of the country.

As a natural outgrowth of the investigation begun in 1888, the so-called Reclamation Act of June 17, 1902, was passed, setting aside the proceeds from the disposal of public lands for the construction of works for the reclamation by irrigation of the arid and semi-arid lands. It has been held that Congress has absolute control over the public lands and of the funds arising from their disposal, and while it might be questionable as to whether the United States could levy taxes, and thus raise money for reclamation, it has been considered that Congress could properly create a trust fund derived from the source named. This fund has amounted to over $60,000,000, and is being added to at the rate of six or seven millions a year. It has been invested in the construction of reservoirs, canals, and distributing systems, and already 27 projects have been initiated or completed, works having been undertaken in each of the Western States and Territories.

Over a million acres have been reclaimed, and 14,000 families are receiving water from works built or controlled by the Government, under the terms of this Act. Reservoirs have been built having a capacity of nearly 5,000,000 acre-feet, that is to say, the water would cover 5,000,000 acres to a depth of one foot. Canals of large size, carrying over 800 cubic feet per second, have been built for a total length of 300 miles, and somewhat smaller canals constructed with a length of a thousand miles including the ditches. There are over 5000 miles of water courses, also nearly 70 tunnels with a total length of about 20 miles. The smaller structures number over 20,000 including bridges, culverts, headgates, siphons, etc. Nearly 60,000,000 cubic yards of earth have been excavated and 10,000,000 of loose and solid rock.

The principal results, however, are shown in the crop production and although the works are hardly built to a point further than to try out portions. It appears that the value of the crops raised in 1910 was nearly $20,000,000, and land-values have advanced from practically nothing to one hundred million dollars. These values will continue to increase as the works near completion.

The object, however, as before stated, is not to make men rich, but to make homes for citizens who will preserve the institutions of the country, and to do this without imposing a burden upon the taxpayers. It has been shown how this is being accomplished by the use of the Reclamation Fund, which is revolving and growing larger and larger, that is to say, as the money comes back from the works completed, it is used over again and is being increased by additions from the disposal of other public lands. Under wise administration the funds should increase and produce larger and larger results in the conservation of the waste waters and the utilization of these in those parts of the United States where rain is infrequent and where the brilliant sunshine can be depended upon nearly every day in the year. It is really the sunlight which is capitalized and made valuable.

The question is frequently asked, why should not the Government reclaim the worthless lands in the East? The answer lies largely in the fact that no other part of the country than the arid West has such wonderful opportunities for crop production, as it does not have the continuous daily sunshine upon which plant life depends. The advantages of the development in the arid region also are greater from the political standpoint, as population is better distributed and is brought nearer to important source of mineral wealth, enabling development of industries in otherwise remote and inaccessible localities.

CONSTRUCTION OF THE TIETON CANAL.

The description of the Tieton canal, built in Central Washington by the Reclamation Service, before the American Society of Civil Engineers, should be most interesting in illustrating a new method which has been worked out to fulfill conditions of rapid flow, a comparatively long canal, a steep and rugged hillside and withal a permanent work fulfilling requirements at a minimum of cost. It was necessary to bring water 14 miles from a diversion in the Tieton River, through a canyon in which all of the problems confronting the Western engineer had to be met and solved. The side of the canyon presented a slope of 60 per cent and the ground formation of clay shales and uncertain rock surface, placed any but a permanent and self contained canal out of the question. It was decided to build a reinforced concrete flume having a circular section, entirely self-contained, i. e. not to be dependent upon outside earth pressure or structure to compensate for the spreading effect of the internal water pressure, furthermore to be capable of sustaining earth pressure from the exterior as from slides or fallen trees and lastly to cause as little disturbance of the ground surface as possible. The difficulty was complicated by the lack of concrete materials near the flume line. It was decided to build the flume in short sections which would dovetail together and be finally joined by cementing. At several flat points, convenient for raw materials, yards were cleared and the sections were molded. These, when properly cured, were hoisted onto specially made wagons and loaded onto car trucks which ran on temporary track laid along the line of canal. By a special placing device they were rapidly and accurately placed in position and cemented. A backfilling of earth was then made for support from underneath.

The wetted area of this canal is 36 sq. ft., the coefficient of roughness in Kutters formula was taken to be 0.012 and the resulting flow of 326 sec. ft., having a velocity of 9.05 ft. per second. The cost of making the concrete forms, hauling and placing, including all overhead expense but not including trenching or placing the ground in condition for receiving the flume, was, $5.80 per linear foot. The paper does not give the results of tests of capacity flow, as, at that time there was not sufficient water in the river to fill the flume, but while some curious and unexpected actions where the direction of flow was sharply changed, have been noted, the method of construction in short sections with cemented joints apparently has little depreciatory effect.

A comparison of costs with open earth canal is interesting. Providing that, in the judgment of the engineer, a section of earth canal is advisable, upon completion there need be little surprise in finding cracks or other breaks, due to blasting or the nature of soil beneath the surface which will need rebuilding or constant repairing after operation. Furthermore the coefficient in Kutters formula may range from 0.02 to 0.03 necessitating a wet cross section that may be double that required to carry the same quantity of water in the concrete flume. Where this work may be done with a steam shovel, the cost per linear foot may range as low as $4.00, but if there is much rock and the locality is more or less inaccessible, the cost may easily range to $6.00 or $7.00.

Flume of the steel type supported on timber structure, which has been adopted by the Reclamation Service in some Rocky Mountain sections, to carry the quantity of water that the Tieton canal is designed for will cost as high as $8.00 per linear foot.

The cost of benching for the sectional concrete flume should be no more than that of constructing a mountain road and in most cases should not be over $1.00 per foot and in no case over $2.00. This would make the total cost of this construction, using the latter figure, $7.80 per foot which compares favorably with the other methods mentioned, with the advantage that the cost of depreciation and maintenance are reduced to a minimum.

In the Tieton project are a number of tunnels lined with sections placed in the same manner as is the flume. The tunnel sections have, however, a circular closed section. For localities where the cost of building and forming the lining in place is not a preventative factor this method of lining might not have an advantage. In this instance the lining, exclusive of the cost of driving the tunnel, cost in place, $8.35 per linear foot.

One tunnel of 3000 ft. of this project, having a hard self-supporting basaltic formation, was lined in the usual way, by building floor and sides of concrete, leaving the natural rock roof. It was found that this construction cost even more than the sectional ring lining which could be used through any formation, proving at least in this case that the new method is not only an improvement in construction but in cost over the form methods of building tunnel linings.

CHIMNEY FORMULA.[1]

BY W. F. DURAND.

In connection with Mr. Dunn's paper on chimney capacities, the accompanying formulae may be submitted as representing conservative practice under what may be denominated approximately normal operating conditions. The factors which enter into the problem of chimney draft and capacity are so numerous, their relations so obscure and values so difficult of numerical determination, that of necessity all chimney formulae are empirical—that is, they are simply practice expressed in algebraic form. The literature of engineering abounds in chimney formulae, but inasmuch as most of them relate to coal burning practice, I have ventured to add one more to the list and intended to refer strictly to oil burning practice.

While as noted all chimney formulae are empirical in character, yet they may to some extent be made rational in form, and the more nearly such condition is realized the better will the formula take care of variations in the operative conditions, outside the immediate range from which the empirical factors are drawn.

The general character of a chimney formula on rational lines may be readily developed, as follows: The function of draft involves the pushing of air into the furnace and the pushing of the gases of combus-

[1]Paper presented at San Francisco meeting American Society of Mechanical Engineers, March 10, 1911.

tion through the tube spaces and then up the stack to the outer air. This involves the work of giving kinetic energy to a body of air and gas and of moving it against a resistance. In general such work will depend on the quantity of gas moved and on the square of the velocity. This work must be supplied by the draft head or difference of pressure between the external air and minimum pressure within the boiler, and per pound the work will be measured by the difference of pressure in pounds per square foot multiplied by the volume of one pound of gas in cubic feet. We have thus in general the relation: $u^2 \backsim VP$ when u = velocity, V = vol. per pound, P = draft head measured in pounds per sq. ft.

Again, let B = boiler horsepower, w = pounds of gas per boiler horsepower, A = area of chimney, then BwV = total volume of gas = Au.

But $u \backsim VP$, and P the draft head will depend in general on the height of the stack and on the stack temperature. According to simple theory of stack draft, such head is measured by the difference in weight between a column of normal air and a column of hot gas each of the height of the chimney.

In any event, we may put $P \backsim hx$ where h = height of chimney and x = a factor or term depending on the temperature.

We have then: $u \backsim \sqrt{Vhx}$ and hence $A\sqrt{Vhx} \backsim BwV$ whence $A\sqrt{h} \backsim Bw\sqrt{\frac{V}{x}}$

In words, the product of the area by the square root of the height should follow closely the product of the number of pounds of gas by the square root of the volume per pound and divided by the square root of the function x.

But the volume of one pound of gas V varies directly as the absolute temperature. This of course varies widely between the furnace and the top of the stack. The temperature at the base of the stack is usually taken, however, as primarily related to the value of the draft function x, and for convenience we may use the same temperature as related in a general way to the value of V.

Also w, the pounds of gas per boiler horsepower, will vary inversely as the boiler efficiency.

Let e denote the efficiency. Then we may write

$$A\sqrt{h} = \frac{B}{Qe}\sqrt{\frac{T_s}{x}}$$

where Q is the general constant or factor.

The function x takes the form $\frac{A}{T_a} - \frac{B}{T_s}$

where A and B are constants and T_a and T_s are absolute temperatures of the air and of the stack. Where draft head d is expressed in inches of water and the height of the chimney in feet, this takes the form

$$d = \left(\frac{7.6}{T_a} - \frac{7.9}{T_s}\right)$$

If 80 degrees Fah. is taken as a fair upper temperature of the air, this reduces to

$$d = \left(.1407 - \frac{7.9}{T_s}\right)$$

The entire square root $\sqrt{\frac{T_s}{x}}$ is therefore a function of the temperature and its value for a range of values of T_s is given in the accompanying table.

TABLE.

VALUE OF TEMPERATURE FUNCTIONS.

t	v
400	4.19
420	4.16
440	4.12
460	4.10
480	4.07
500	4.05
520	4.04
540	4.03
560	4.02
580	4.01
600	4.00
620	4.00
640	4.00
660	4.00
680	4.00
700	4.00

It now only remains to find a value for the numercial constant Q. This has been done by using the results of practice and thus checking the formula against the indications of experience.

In this manner, we find as follows:

$$(A - a)\sqrt{h} = \frac{By}{Qe}$$

where A = area of chimney in sq. ft. a = small constant area as below; h = height in feet; B = boiler horsepower actually developed, which equals number of pounds of total evaporation per hour reduced to conditions from and at 212 deg., divided by 34.5; e = boiler efficiency; y = temperature factor from the table; Q = coefficient.

a and Q have values as follows:

For large chimneys or from 300 b.h.p. up

$$a = 2.5 \quad Q = 54$$

For small chimneys or from 500 h.p. down

$$a = .6 \quad Q = 40$$

In choosing the values of these constants Q the following special conditions are assumed:

Heat value of oil fuel............about 18,500 B.t.u.
Temperature of external air...............80 deg. F.
Excess of air in furnace, about..........100 per cent

Boilers working at rate of output not greatly exceeding rated load.

The particular numerical factors in the formula are perhaps not so important. I dare say further investigation—undoubtedly the results of Mr. Weymouth's data might change the numerical factors. I believe however that the form of the formula may possibly be of some aid in passing from one set of conditions to another, or interpolating between various sets of conditions; and that is about all any engineering formula can hope to do.

DISCUSSION AT SAN FRANCISCO MEETING A. S. M. E.

Atomization of Fuel Oil.[1]

W. F. Durand: In connection with the paper by Mr. Hunt on atomization, I have been interested in estimating the work equivalent of this process. The nozzle of a burner is a more or less effective device for transforming energy of steam into jet energy, exactly in the same manner as does the nozzle of a steam turbine. The atomization of the oil and its projection at high velocity into the furnace involve the expenditure of work, and this work must be derived from the steam by way of the nozzle.

One-half pound of steam per pound of oil is perhaps a fairly representative figure for the amount of steam required. This amount of steam used with any reasonable nozzle efficiency and under the conditions of say 90 pounds initial pressure absolute and 15 terminal, should develop from 35,000 to 40,000 ft. lb. of energy, thus expended in work on the oil. This figure is impressive. It is probable that due to wire drawing and inefficiency in the nozzle the amount of work actually utilized is less than this figure. In any event, however, the price paid for the preparation and introduction of the oil into the furnace is a heavy one, and the question not unnaturally arises as to whether or not this can be the ultimate method. May not some method be developed, mechanical or otherwise, which shall enable us to do the necessary amount of work on the oil without the heavy expenditure involved in the present systems of steam or air atomization. Mechanical atomization seems to present some possibilities and it may be that the future development may lie along this path. In any event, I feel that as engineers we should entertain a feeling of profound discontent with our present methods of preparing and introducing the oil into the furnace, and that we should not rest until either some less costly method is developed, or every possible method and expedient has been given a thorough trial.

Thos. Morrin: With a view to seconding Professor Durand's last statement (although I was not aware that he was going to take up that subject) I wish to read a few notes: The use of crude oil as fuel has been developed along the lines of unlimited extravagance in the vaporizing process, and has been perpetuated from one scheme to the other in the same line of application and operation.

Until recently the prevailing land practice has been to use a steam jet from the boiler at full pressure to vaporize the oil at the burner tips, for the simple reason of its convenience and its low cost of application. This is perhaps the most expensive method for accomplishing this object. Some types of burners requiring much less vaporizing medium than others, but none of them are economical, and all of them susceptible of great waste, limited only by the size of steam connections and the pressure of that medium.

I believe that these conditions cannot be materially changed, except by providing a burner mechanism that will require air only at an extremely low pressure that may be furnished at a minimum cost, so that its most extravagant use could never exceed a certain fixed range.

Here I beg to take exception to that part of Mr. Hunt's paper in which the form of the burner is referred to as of minor importance, as I am convinced that it has considerable to do with preparing the oil for satisfactory combustion, inasmuch as it is necessary to vaporize the oil or work it up into minute atoms the method of accomplishing this atomization must necessarily depend to a great extent on the burner.

I have in mind what might be called mechanical burners inasmuch as they are of the rotating or of the turbine fan wheel type, rotating at a high speed and delivering the oil from the periphery of the burner at a velocity approximately 7100 ft. per minute, equal to an air pressure of approximately 1½ ounces per square inch.

In tests made as to the quantity of oil and the percentage of power used to burn a fixed quantity it was noted that the energy expended to accomplish this result was less than 1 per cent. In fact, the figures showed an actual consumption of energy amounting to but 0.6 per cent of the actual heat results of the oil burned. This energy expended not only vaporizes the oil but it delivers the oil and a full quantity of air for complete combustion, which if segregated, would perhaps reduce the actual energy expended for atomizing the oil to less than 0.4 per cent.

Another plant uses 660 pounds of oil per hour with jet burners and air at pressures in two different blasts, while with jet burners of 6 ounces and 6 pounds per square inch, respectively, the volumes are in the proportion of 80 per cent at 6 oz. and 20 per cent at 6 pounds. No reliable data is available on the operation of this plant, but from a careful observation of the plant under full operation and giving the most satisfactory results from the basis of cost and maintenance and the efficient use of the oil, and allowing the highest possible amount for energy consumed in the vaporizing, we get a loss not to exceed 1½ per cent, which if correctly measured and checked up would not exceed 1 per cent of the energy in the oil.

I refer to this scheme of vaporizing oil for the reason that I am sure that oil will be used more and more and also that its application for fuel purposes may be increased if we convince the consumer that it is not necessary to install a steam boiler or an expensive and elaborate mechanical equipment to utilize this kind of fuel. A simple centrifugal blower and a rotary geared pump driven by one electric motor that any unskilled person may use and operate is possible.

The great difference in cost and the much more convenient use of oil fuel as compared with coal, have been so favorable that we have overlooked this feature of the economical application of oil as fuel, until it is now being applied to household uses requiring a simplified apparatus, which can be safely and economically operated by unskilled male and female servants; in fact, fool proof. In this transition the use of air under low pressure has proven a great step forward in the use of oil as fuel.

In this respect the form of furnace is also important. The hearth of the furnaces should be of good fire resisting material, of high radiating efficiency, and thin, with air inlets well diffused over the surface. While it is not necessary to heat the air for the best and most economical utilization of its heat units, it has been proven that oil can be burned in the jet process with much less noise with heated air than with cold air.

This system of vaporizing oil is just as applicable to the service on board ship as it is to the most remote fruit dryer, hop kiln or malt houses, where it would be only necessary to install a small motor and volume blower, with the necessary oil pump, within the prescribed limits of the Underwriters, thereby placing the application of fuel oil without expensive cost to almost any service requiring fuel.

I am satisfied that with this method of vaporizing the oil, less energy per pound of oil burned will be required than in any other form now in use, and it should receive more attention from engineers and consumers than in the past.

These are not new schemes or new ideas, but have been in use to my certain knowledge for six years in San Francisco, but with indifferent success; but recently have been improved to a considerable extent. So much so that their efficiency is far and away ahead of the usual steam or high pressure air method of vaporizing oil.

[1] Journal of Electricity, Power and Gas, Mar. 18, 1911, page 237.

Use of the Orsat Apparatus.

Mr. Bailey: To learn the efficiency of the furnaces in the station of The Municipal Light & Power Co.'s plant in San Francisco, we installed an Orsat apparatus in the fireroom. The four boilers are of Stirling make, and the samples were taken about a foot below the damper. The sampling tube used in each was a piece of ⅜ in. iron pipe, open at the end. Small lead pipes from each furnace were run to a header with a valve in each, so that a sample could readily be taken from any of the furnaces. A small water ejector was connected to the header to insure drawing over a fresh quantity of flue gas before a sample was taken. We experienced trouble with the lead piping from pin-hole air leaks, and from the piping sagging and forming pockets, which trapped water from the products of combustion and prevented a flow of flue gas. These troubles were overcome by the use of ¼ in. iron pipe.

The Orsat determinations were of great value at the start in educating the firemen as to the amount of air required. All of our men were experienced in the burning of fuel oil, but they were firing with from 80 to over 150 per cent excess air. By shutting down on the draft and making frequent determinations with the Orsat apparatus until a high per cent of CO_2 was obtained, the firemen were taught how a fire should appear with the minimum amount of air for complete combustion. We were unable to get much better than 12 per cent CO_2, as above this point the fire is liable to produce smoke, which would not be long tolerated in the neighborhood of our plant.

Although we had no direct means of measuring the economy due to better firing, an increase in kw. hr. per barrel of oil followed at once. The second month we had the Orsat installed, we showed an increase of 19.3 per cent in the kw. hr. per bbl. of oil obtained the month before installing the Orsat. During this period the load factor on the turbine increased from 43 per cent to 53.5 per cent, which would account for some of the increase in economy, but hardly for the amount obtained.

The Orsat apparatus is not a suitable instrument for constant fire room use, as the rubber connections rapidly deteriorate and the glass parts get broken. It is well worth its cost, however, as it will awaken and maintain in the firemen a lively interest in the subject of combustion, which is sure to result in better firing.

In order that the firemen may appreciate the importance of maintaining a high per cent of CO_2, we have posted in the fireroom two curves, one of which gives the relation between per cent of CO_2 and per cent of excess air; the other, the relations between the per cent of excess air, flue temperature, and calculated boiler efficiency.

To measure the oil in our fuel tanks, we run to each a ¼ in. brass pipe, which is run through the top of the tank to a point close to the bottom. To each pipe, at a convenient point in the engine room, a U tube containing mercury is attached. Each pipe is connected to the compressed air system of the plant. To read the height of oil in a tank, the compressed air is turned into the pipe until it blows out the oil which may be standing in the vertical section leading down to the bottom of the tank. The air is then throttled down so that only a small amount escapes through the oil, and a reading taken of the difference in level of the mercury in the U tube.

A scale alongside the U tube can be calibrated by means of known quantity of oil in the tank, so as to read direct the number of barrels contained in the tank at any time. In a tank 13 ft. deep and holding 110 barrels, we can read within a barrel of the true amount in the tank. By inclining the tubes so as to get a longer range of movement of the mercury, greater accuracy could be obtained. Should the gravity of the oil change from that used when calibrating the U tubes, the readings must be corrected for the difference in gravity.

Making Producer Gas from Oil.

J. A. Yeatman: California oil is a heavy oil, and is not freely vaporized. To prepare the oil so that it might be vaporized and burned in a gas engine, experimenters at first used what are known as gas-engine retorts, heated either externally or from the gas engine exhaust. As the California oil contains a deposit of clay or earthy matter which the oil companies were not extracting, the retorts would foul in a short time and become incrusted with carbon and dirt, so that they could not be made to operate continuously. Consequently their use was practically abandoned. In endeavoring to further the use of the heavy oil they took up the gas producers, designed much along the lines of the hard and soft coal producers of the East. But it was found that the percentage of hydrogen was so great, and the creating ignition in the standard gas-engine so troublesome that they had to reduce the compression, and then it often failed to ignite if the proportions were not correct. This was also practically abandoned.

Then Mr. Frost developed the Frost engine producer, which works well but requires gas engines of excessive bore and stroke for a given amount of power, which increases the friction in the engine. The device, while simple to an engineer, is quite complicated to the average small gas-engine user.

There was another producer put on the market in Southern California with which they have had considerable success; but it has its defects because it has a tendency to foul, and when they provide means for overcoming the congestion the gas varies and the results are somewhat problematical.

Some twelve or fourteen years ago I read a lengthy mathematical discussion of the Diesel gas engine and I was convinced at the time that a modification of burning the oil directly in the cylinder would probably be a success; but owing to the high compression required as the matter was then understood, such engines were practically impossible.

In order to use California oil in gas engines it is necessary to extract the residue in the oil. The oil companies have put in centrifugal separators, which leaves the gas engine manufacturer free to operate his gas engine without fouling the cylinders. Most of the ordinary carburetors are based on what is known as the suction principle, and the force is not sufficient to atomize the ordinary 10, 12, 16 and 18 gravity oils. Some gas engine manufacturers have developed an atomizing mechanism, which takes the place of an ordinary suction carburetor; and considerable success has been had along those lines during the past two years. I have been reliably informed by engineers who have observed tests that they have been able to produce a horsepower with .4 lb. California crude oil of 14 gravity by direct atomization after it had been strained by a centrifugal separator. This marks probably the greatest progress towards getting economical power that I know.

The Diesel Engine.

The Chairman: Mr. Yeatman's remarks remind me that we have had almost nothing with reference to the question of the direct combustion of the fuel in the cylinder. It is a subject which in itself might form the topic of an evening's discussion. Why the Diesel motor has never made any stand for itself in this country has always amazed me. There are certain troubles inherent in it, and yet abroad it has been used to a very considerable extent, and even in units of quite considerable size. Here however it has never gained a foothold.

G. H. Marx: Since this topic has come up, it occurs to me that in 1904 I visited the laboratories at Munich, and was shown the engine on which Professor Shroder had performed his experiments, by his assistant, who assured me that at that time they had used California crude petroleum in some of their tests, and that the petroleum had worked satisfactorily, and left no residue in the cylinder.

Howard Stillman: While we are on that subject I would like to make a few remarks covering the operation of Diesel engines. The Southern Pacific Company had one in the Ogden shop, and I made a number of tests with it; and the economical performance of that engine was of course far in excess of anything that we had. It was first exploited as an engine with which we might use the California petroleum oil; and some few attempts were made to operate with California crude oil, but it was an utter failure. The engine would run about five minutes sometimes, and sometimes half a day, and another day the shop was tied up for lack of power. Finally we went to a lighter distillate, and with it it worked well, and was economical in its performance; but even with that oil had its defects. The theory of this engine cannot be excelled, but the personal equation came into it. We could not keep the shop going. The managers tired of making repairs on it. Sometimes we had records of three weeks at a time when the engine's performance was wonderful, and then would come a period of say two weeks when the old steam engine had to be used.

Some time after this, a larger unit was installed at Tucson and was operated for three years. The same attempts were made to use a crude oil, or a lower gravity oil, with it, but it was intermittent in its action. It finally got down to a fuel oil (I think from Texas) of lighter gravity than the California oil, and its performance was fairly good. But it had its difficulties. When it was working it was a splendid machine. I think there were about 300 men in the machine shop and all the power was generated from this Diesel motor, connected with the shop shafting, and the stationary engine that formerly ran the shop was still in place. There was one attempt made to dismantle the steam engine, but fortunately they had only taken off the blocks before the Diesel motor was hung up for repairs. After that they never attempted to discard the reciprocating steam engine, which was fortunate, as we had a number of troubles with that Diesel motor. It was under repair much of the time, and finally we abandoned it. They found there was no net economy in operation, because no one could tell when it was going to stop.

Mr. Fenn: When I was in Chili last year I saw a number of Diesel engines in operation, and inquired particularly about them from the chief engineers in charge. They pronounced them satisfactory, but they were using a Peruvian crude of 34 gravity. When I came back to this country we took up the question of using our oil, and the Diesel company refused to respond for any California oil heavier than 19 degrees.

Mr. Bell: I think the United Verde mine have just purchased a 1000 h.p. unit, without paying any attention to where the oil was coming from. The Associated Company shipped them a light crude. They could not do anything with it, and now we are sending them a sample of oil and distillate of different parts of the fields of California, to try and get that engine to run successfully. It must be in the California oil itself which has this carbonizing effect, that interferes with these engines.

Thos. Morrin: In regard to using crude oil, and the fouling of carburetors I once had occasion to inspect all of the carburetors made in and around this vicinity in the interest of an eastern manufacturer that was producing a large number of gas engines. From my experiments I found it best to use duplicate carburetors and when one fouled to change to the other. By feeding water through the dead carburetor while yet hot, the dirt and carbon would sluff off easily and quickly.

Mr. Fenn: I would like to add one word to what I said, that is, that it is not in the California oils perhaps that the trouble lies, but rather in the gravity, because they are using some of our distillates that are of 31 or 32 gravity. The distillates from our crudes they are using in engines.

Howard Stillman: The oil that we used on the Diesel engine at Tucson had a gravity of about 30 degrees. I should put that limit, about 25 or 30 degrees oil. I would not use under 25 degree oil in the Diesel engine.

The Chairman: The comparison of the distillate with the crude I think is hardly legitimate. It would seem to me that the crude, even though of as high gravity as the distillate, might contain products that would tend to cause fouling; whereas your distillate would be a more uniform product, and with less or no other product in it.

Mr. Fenn: I perhaps misunderstood. I understood him to say that the California distillates had proven unsuccessful up north.

Mr. Bell: No. They tried one of 22 gravity from the Sunset Monarch refinery in Sunset, which proved unsatisfactory. But they are now trying a 30 and 40 gravity, and I do not know with what success at this time.

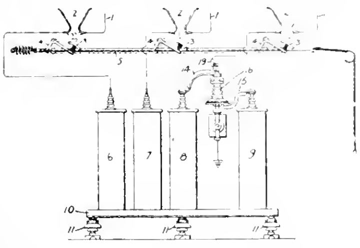
C. R. Weymouth: I would like to second some of Mr. Dyer's remarks about the character of the papers presented, and express the hope that this will not end the session on fuel oil. Personally I am in touch with a large number of Eastern engineers, who are considering in lively fashion the adoption of the use of crude oil by a number of Eastern plants; and I know that our eastern membership looks to the Pacific Coast for information on oil burning. I believe we have quite a number among us who are capable of treating the question of crude oil more explicitly and more generally than it has so far been treated; and before we cease this subject we ought to try to prepare an encyclopaedia on crude oil which will stand for a long time to come, and do credit to our local branch's first attempt. I believe Mr. Hunt himself, and a number of others, could prepare an article of a general character which would be a masterpiece; and I hope that the committee will not let this go forward as the final effort of the San Francisco engineers.

The Chairman: In that connection I would say that the general idea has been constantly present in my mind, both at the first meeting and at this; and it has been my intention to suggest to our committee on local meetings that, if we can arrange it within the finances allowed us from the parent society—if not I think we can probably get contributions to arrange it—to hold an intermediate meeting between this and our next three months' interval, so as to continue the matter: and if that is not sufficient we will still keep at it, because I think there is no subject which is of more vital interest to us here and on which we can contribute more value; and I shall be very glad to follow up the suggestion and do what I can to see it carried out.

Newly elected associate members of the American Institute of Electrical Engineers include W. R. Battey, designer for Southern California Edison Co., Los Angeles; A. L. Bradley, draughtsman Pacific Electric Engineering Co., Portland; L. P. Crim, engineer Pacific T. & T. Co., Seattle; E. W. Currier, electrical salesman Fairbanks, Morse & Co., Los Angeles; H. S. Curtiss, switchboard attendant Portland Railway, Light & Power Co., Portland; F. C. Ensinger, superintendent electric meter department San Francisco Gas & Electric Co., San Francisco; R. H. Fenkhausen, chief engineer Risdon Iron Works, San Francisco; G. G. Gunderson, manager electric department H. W. Johns-Manville Co., South Seattle; C. A. Harmony, city electrician Centralia, Wash.; V. H. Haybarker, electrician "Oregonian," Portland; C. M. Hoskinson, draughtsman Great Western Power Co., San Francisco; C. J. Kephart, student University of California, Berkeley; J. C. Love, Sacramento Electric, Gas & Railway Co., Sacramento, Cal.; J. A. Smith, switchboard operator, Washington Power Co., Reardon, Wash.; J. Z. Strauch, superintendent electric meter department, Sacramento Electric, Gas & Railway Co., Sacramento; C. E. Thomas, sales agent General Electric Co., Los Angeles; H. E. Truax, electrical machinist Bremerton, Wash.; A. N. Voss, foreman Goldfield Consolidated Mines Co., Goldfield, Nev.

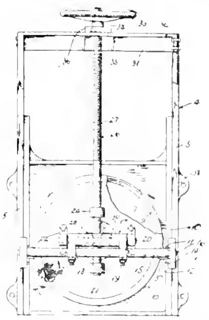
PATENTS

989,487. Lightning-Arrester. Elmer E. F. Creighton, Schenectady, N. Y., assignor to General Electric Company. The combination with three conductors of a transmission system, of four electrolytic condensers mounted side by side with corresponding terminals in electrical connection and

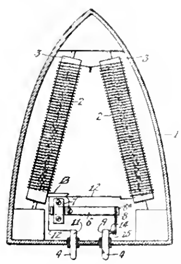


the other terminals of two of said condensers directly connected to two of said conductors, and a transfer switch connected to the third conductor and mounted to co-operate with the terminals of the two remaining condensers and thereby connect at will either of said remaining condensers to ground and the other condenser to said third conductor.

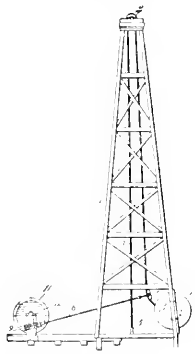
989,202. Head-Gate. Frank P. Snow, Los Angeles, Cal., assignor to Kellar-Thomason Manufacturing Company, Covina, Cal. In a device of the class described, a frame having a seat, a disk adapted to come against said seat, a stem carrying said disk and having a limited sliding movement on said disk, means for raising and lowering said stem to withdraw said disk from said seat, means for arresting the movement of said disk adjacent to said seat, and means for moving said disk upon said seat when arrested.



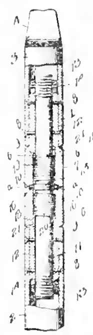
989,273. Thermostatic Control for Electric Heating Devices. Elmer C. McBride, Santa Ana, Cal. A thermostatic controlling means for electric heating devices comprising a fixed terminal means provided with a contact point, a thermostatic bar supported at one end and having at its other end an arm provided with a contact point for co-operation with said fixed contact point, means for connecting the said bar and terminal in the electric heating circuit, said bar being relatively rigid and said arm thereon having a slight elasticity in order to prolong the intervals of contact and of disruption of the circuit substantially as set forth, and means for adjustably supporting said thermostatic bar to adjust the relative position of the aforesaid contact points.



989,184. Well-Drilling Apparatus. Samuel S. O'Connor, Santa Monica, Cal. In a well drilling apparatus, in combination, a drill line having a drilling tool secured thereto, a rotatable crank arm, a block pivotally secured to the crank arm, a frame slidable on the block and having end pieces located on opposite sides thereof, a spring bearing between one of the end pieces and the block, a headed rod passing through the other end piece, a jerk line secured at one end to the rod and connected at the other end with the drill line and a second spring bearing between the rod-head and the last mentioned piece.



989,112. Trolley-Pole. Charles E. Bradford, Lakeview, Wash. A trolley pole having tubular alining members disposed end to end, and provided in their meeting ends with segmental slots, in combination with a spindle connecting said members, and to which they are swivelly connected, said spindle having radial stop studs operating in said slots of said tubular members, and reversely coiled springs on said spindle, and in said tubular members, one end of each spring being connected to said spindle and the other end being connected to one of said tubular members.



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POWER AND GAS

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E. B. STRONG, President
A. H. HALLORAN, Vice President and Managing Editor
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DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG
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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

In the vast region from "the Rockies to the Coast," many hydroelectric and irrigation systems have been designed in accordance with unique rule-of-thumb methods, whose use dates back to the pioneer settlers who had few facilities in a new country of peculiar climatic conditions. The characteristically mild winters and long, dry summers allowed the construction of rock-fill dams, wood flumes and earth canals which have withstood the test of time, but which would have been impracticable in other less-favored sections. While they satisfied the rude needs of the hydraulic miner they are not so well adapted to hydroelectric and irrigation service and are gradually being supplanted by modern engineering methods.

Modernized Hydraulic Construction

Many engineers of high standing have come into the West for the first time with the avowed purpose of improving these crude efforts of the early hydraulic miners, whose judgment, as based upon hard experience with timber, rocks and floods, dictated this style of construction. Their failure has been as signal as would be that of the pioneer Western miner under equally strange conditions in the East. The difference between good and bad engineering rests in the success or failure of its result, and it is only by a full appreciation of those conditions which have developed the individuality of the Western mountain engineering, that these structures can be made stable.

Among the greatest hydraulic projects of today are those which are being carried out by the Reclamation Service, whose engineers have combined the old common-sense methods with all that modern thought and practice can suggest. Provided with every facility, they are now developing a new type of construction such as is exemplified in the Tieton canal described elsewhere in this issue, and which employs a reinforced concrete flume to meet the exacting conditions of the rapid flow of much water through long canals which must be at once permanent and cheap.

The box-flume is a relic of the days of cheap and abundant timber, when depreciation and replacement were as unconsidered trifles. Canals excavated in earth or rock may often be safely used in the mountains, but even these must ultimately be rebuilt in more permanent form. Choice is consequently narrowed to steel or concrete, either as pipe or lining. Concrete is less subject to deterioration, but its first cost is sometimes prohibitive. Where there is a permanent and sufficient ground backing, as is the case with the Los Angeles aqueduct, the end justifies the means, but to obtain a self-contained canal having a high factor of safety against slides, earthquakes, wet snow and even falling trees and at the same time keep within a unit cost which will not vitiate the earning power of the project, the plan which has been put into effect in the Tieton project seems admirable.

PACIFIC COAST MEETING OF NATIONAL ELECTRICAL SUPPLY JOBBERS' ASSOCIATION.

The first Pacific Coast meeting of the National Electrical Supply Jobbers' Association will be held at Del Monte, California, April 25, 26, 27, 1911. A 9-car train, leaving Chicago on April 18 is scheduled to arrive at the Hotel Del Monte on the evening of the 24th, with stops at the Grand Canyon and Los Angeles. The program for the meeting follows:

Tuesday, April 25th.

10 a. m.—Jobbers' first session.

10 a. m.—Ladies will visit Monterey, Old Mission, Presidio, Pacific Grove and points of interest.

1 p. m.—17-Mile-drive. Ladies, jobbers and manufacturers, as guests of the San Francisco manufacturers' representatives.

8 p. m.—Concert in ballroom.

8 p. m.—Jobbers' second session.

Wednesday, April 26th.

9 a. m.—Manufacturers' qualifying round at golf, 18-holes medal play. A trophy to be presented by Hotel Del Monte to player making lowest score. One-half dozen golf balls will be presented the player making nearest the average score.

10 a. m.—Ladies entertained by trip to Marine Gardens at Pacific Grove as guests of the Pacific Coast Jobbers.

10 a. m.—Jobbers' third session.

1 p. m.—Jobbers' qualifying round at golf, 18-holes medal play. A trophy will be presented by Hotel Del Monte to player making the lowest score. One-half dozen golf balls will be presented to player making score nearest the average.

2 p. m.—Trap Shooting. Trophy to be presented to the winner.

2 p. m.—Tennis Tournament. Open to manufacturers and jobbers. A trophy to be presented to the winner and runner-up.

2 p. m.—Ladies' Tennis Tournament. Suitable prize to be presented to the winner.

8 p. m.—Jobbers' fourth session.

9 p. m.—Dancing in the ballroom.

Thursday, April 27th.

9 a. m.—Manufacturers in final 18-hole medal handicap Golf Tournament, consisting of three flights—10 in first, 10 in second, balance of players in third. Trophy to be presented to the winner and runner-up of first flight. Trophy to be presented to the winner of second flight. Trophy to be presented to the winner of third flight.

9 a. m.—Jobbers' fifth session.

11 a. m.—Jobbers in final 18-hole medal handicap Golf Tournament, consisting of three flights, 10 in first, 10 in second, balance of players in third. Trophy to be presented to winner and runner-up of first flight Trophy to be presented to the winner of second flight. Trophy to be presented to winner of third flight.

11:30 a. m.—Luncheon to the ladies at Pebble Beach Lodge, as guests of the Hotel Del Monte.

Note:—Automobiles will be at entrance to convey the ladies to the lodge. The automobiles are furnished with the compliments of the Pacific Coast Jobbers.

1 p. m.—Pool tournament. Open to manufacturers and jobbers. Trophy to be presented to winner and runner-up. This Pool Tournament is under the supervision of T. E. Burger.

7:30 p. m.—Spanish Dinner in Monterey for everybody. Many novel features.

PACIFIC COAST MEETING A. I. E. E.

The 1911 Pacific Coast Convention of the American Institute of Electrical Engineers is to be held in Los Angeles, Tuesday, April 25th, to Friday, April 28th. The sessions are held under the auspices of the Institute through the direction of the Telegraphy and Telephony, the High Tension Transmission, and the Railway Committees. Thus it is not a local meeting, but one in which the entire Institute membership has a part, and particularly those residing on the Pacific Coast. Headquarters will be in the Hotel Alexandria. The program for the meeting follows:

Tuesday, April 25.

Registration.

Auto trip through Los Angeles, Hollywood, San Fernando Valley and Pasadena for the ladies.

Section dinner for members and committees.

Wednesday, April 26.

Morning: Business.

Afternoon: Trip over Pacific Electric Railway, ending at Mt. Lowe, with dinner at Alpine Tavern. Ladies invited.

Thursday, April 27.

Trip via Salt Lake Railway (ladies included), to Redlands, Riverside and other points of interest. Luncheon at Santa Ana Canyon.

Dinner at Mission Inn, Riverside.

Business meeting in evening at Riverside.

Friday, April 28.

Business meeting.

Saturday, April 29.

Arrangements are being made for all who can stay over Saturday and Sunday to take an ocean trip to Santa Catalina Island. This is a most enjoyable trip and well worth waiting for. Return trip from the Island can be made Saturday night, if necessary.

The Southern Pacific Company will authorize reduced fare of one and one-third limited first class fare per capita on receipt-certificate plan from stations in California, including Reno, Nev., to Los Angeles, tickets to be on sale for going trip April 15th to 28th and certificates to be honored for return at one-third fare, providing there are 50 or more delegates in attendance holding properly issued receipt-certificates or round trip tickets. April 25th to May 1st to stations in California south of and including Santa Barbara and Bakersfield, and April 25th to May 8th to stations north of these points.

TRADE NOTES.

The Pittsburg-Silver Peak Gold Mining Company of Blair, Nev., has purchased from the General Electric Company one L.M.—103—A 1—4½-ton—24-inch gauge—250 volt, mining locomotive.

The Honolulu Rapid Transit & Land Co. of Honolulu has purchased from the General Electric Company ten straight-air brake equipments. for double-end operation, complete with "C. P. 27" air compressors.

Fowler & Mallett, agents for the Enos Company of New York, recently opened a large store at 353 Sutter street, San Francisco, where they have added a retail department. A large stock of high-class electric fixtures is now being shown.

S. H. Frank & Co. of Redwood City have purchased from the General Electric Company one C. C. 2, 35 kw., 3600 r.p.m., 250 v. no load, 250 v. full load, compound-wound Curtis turbine generating set arranged for 125 pounds steam pressure, together with switchboard. It will be used to drive electric motor for grinding tan bark.

PERSONALS.

Geo. Morton, of the Dow Pump Company, is at Los Angeles.

F. M. Blackburn, formerly of Salt Lake City, is now in charge of the municipal power plant at Eugene, Ore.

Hugh T. Duff, president of the Woodill-Hulse Electric Company, of Los Angeles, was a recent San Francisco visitor.

W. G. Hutchinson, an electric fixture manufacturer of Los Angeles, was a recent San Francisco visitor.

K. G. Dunn, electrical engineer with Hunt, Mirk & Co., returned to the San Francisco office this week after a trip to Portland.

E. P. Morphy, secretary of the Home Telephone & Telegraph Company, of Los Angeles, was a recent San Francisco visitor.

A. J. Wallace, president of the Sinaloa Land & Water Company, recently arrived at San Francisco from Los Angeles.

L. M. Peart, general superintendent of the San Joaquin Light & Power Corporation, recently spent a few days at San Francisco.

H. F. Eicher has arrived on the Pacific Coast from the factory of the Fort Wayne Electric Works and will locate at the Seattle office.

J. W. White, of the sales department of the Fort Wayne Electric Works, has returned to the San Francisco office after a Southern California tour.

O. B. Coldwell, general superintendent of the light and power department of the Portland Railway, Light & Power Company, is making a trip East.

George R. Field, assistant general manager of the Great Western Power Company, recently visited the hydroelectric transmission plant at Big Bend.

W. G. B. Euler, power house superintendent at the Great Western Power Company's Big Bend plant, recently visited the company's San Francisco office.

Samuel F. Keith, is now chief engineer of the power plant in the Humboldt Bank Building, succeeding Chief Engineer Lindsay, who resigned to go into the contracting business.

W. F. Lamme, formerly with the Westinghouse Electric & Mfg. Co., and Charles T. Phillips, have opened offices as consulting electrical engineers in the Pacific Building, San Francisco.

A. S. Crane, hydraulic engineer of J. G. White & Co., of New York, who recently arrived on the Pacific Coast, has gone to the Crane Valley and Southern California on an inspection tour.

C. E. Hardy, formerly electrical engineer with the Mare Island Navy Yard, is now connected with the San Francisco office of the Westinghous Electric & Manufacturing Company as industrial and application engineer.

S. G. McMeen, having resigned as vice-president and general manager of the Bay Cities Home Telephone Company, to devote more time to the engineering work of McMeen & Miller, is returning to Chicago by way of Del Monte and Los Angeles.

H. H. Noble, president of the Northern California Power Company, returned last week from a tour covering the Noble Electric Steel Company's plant at Heroult, Cal., as well as the hydroelectric system. He says that the Coleman plant will be completed and transmitting current within the next three months.

L. A. Somers, of the sales department of the Westinghouse Electric & Manufacturing Company, returned to the company's San Francisco office during the past week from the factory at East Pittsburg.

F. M. Smith, president of the United Properties Company, controlling the Oakland Traction and the Key Route system, of Oakland, returned last Wednesday from a trip to New York, in connection with completing the organization of the new holding corporation.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast offices, spent the past week at Los Angeles and other points in Southern California. He inspected some of the work which his company is doing for the San Joaquin Light & Power Corporation. Good progress is being made on the extension of the Crane Valley development and two additional General Electric generators of 4000 k.v.a. capacity have been shipped to the plant. At the Bakersfield steam plant a 2500 k.v.a. generator has been started up and a 6250 k.v.a. unit is being installed.

NEW CATALOGUES.

Bulletin No. 1624 from the Allis-Chalmers Company illustrates and describes their standard single storage centrifugal pumps.

The Sprague Electric Company have issued a handsome catalogue of Sprague Electric Fans for 1911 for both direct and alternating current circuits.

Bulletin No. 130, recently issued by the Crocker-Wheeler Company, contains information on their small direct current generating sets, 1.75 to 21 kw.

Bulletin No. 4817, issued by the General Electric Company, describes that company's 75 h.p. direct current commutating pole railway motor which represents the latest construction in this class of apparatus.

The Chamber of Commerce of San Francisco have issued the first number of their "Journal," an interesting and creditable publication summarizing trade conditions on the Pacific Coast and in all the great commercial, financial and trade centers of the world.

Bulletin No. 1079 from the Allis-Chalmers Company is concerned with steam turbines and generators, the turbine being a modified Parsons type, which is lucidly described by text and drawing. The catalogue is further illustrated by a large number of half-tone engravings of typical installation of Allis-Chalmers high pressure condensing, high pressure non-condensing and low pressure condensing turbo-generator installations.

Geo. E. Dow Pumping Engine Company of San Francisco have issued a handsomely printed catalogue on Agricultural Pumps. Aside from the excellence of the typographic make-up it contains much valuable data on the choice of pump types for various work, instructions for installing centrifugal pumps, information on ditch construction and a tabulated statement of the amount and pressure of air necessary to raise water. The arrangement is such that a page of data alternates with a page of description.

Bulletin No. 1003, describing magneto convertible non-multiple switchboards with self restored line signals, has just been issued by the Western Electric Company. The switchboards described are so designed that they can be used originally for magneto service and can be converted at will to central battery operation. They are recommended for exchanges where the ultimate number of lines will not exceed 500. The bulletin is illustrated with wiring diagrams of circuits and with many views of the apparatus used in convertible switchboards.

INDUSTRIAL

A NEW METHOD OF MOTOR CONTROL.

The acceleration of electric motors has in the past been accomplished by different starting devices varying from a simple hand operated type to the magnetic switch motor starter. A magnetic switch starter, by the proper operation of magnetically operated switches, cuts out, step by step, the starting resistance. Such operation is automatic and in a properly designed apparatus affords thorough protection to the motor and to driven machinery. A magnetic switch motor starter is expensive and complicated but despite these handicaps it has been widely used in connection with large motors and for automatic control, because of its obvious advantages. Without attempting to enter into a discussion of existing motor starters, it can be stated, wihout fear of contradiction, that the highly desirable automatic and protective features are secured only at the expense of relatively high cost and complication involving a multiplicity of parts, sensitive relays, and coils wound with wire as fine as thread.

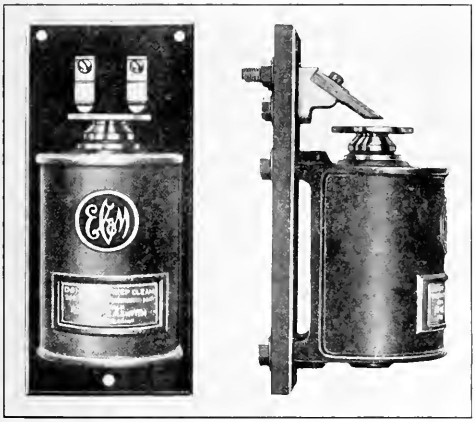


Fig. 1.

The Electric Controller & Mfg. Co. of Cleveland, Ohio, has discovered and developed commercially a magnetic switch radically new in principle and operation. This switch has an operating coil which is connected in series with the motor to be started, this coil being composed of a few turns of heavy wire of fire-proof insulation. The switch has the remarkable characteristic of inherently and automatically closing its contracts only when the motor current is below a predetermined value. It is in other words a combined magnetic switch and current limiting relay. If the motor current flowing through this switch exceeds a predetermined value this switch will lock out and will not close until the current has been reduced by the speeding up of the motor. A train of these switches cutting out the starting resistance step by step provides a method of motor acceleration which is absolutely automatic and protective, and it accomplishes this with apparatus so simple that its expense will not prohibit its application for the starting of any electric motor.

The front and side views of such a magnetic switch are shown in Fig. 1. The operating coil is enclosed and protected by a cylindrical iron shell mounted on a slate panel; at the top are two copper laminated brushes which, when the switch operates, are short circuited, thereby cutting out a section of resistance. At the bottom of the coil shell a movable plug is provided for adjusting the amount to which current must fall before the switch operates; screwing in this plug will increase the lock out value, and, of course, screwing out the plug will reduce the value of the lock out current.

Fig. 2 exhibits the operating characteristics of the switch. Here vertical distances represent current flowing through the operating coil; horizontal distances, positions of the adjusting plug. The shaded area indicates the operating limits of

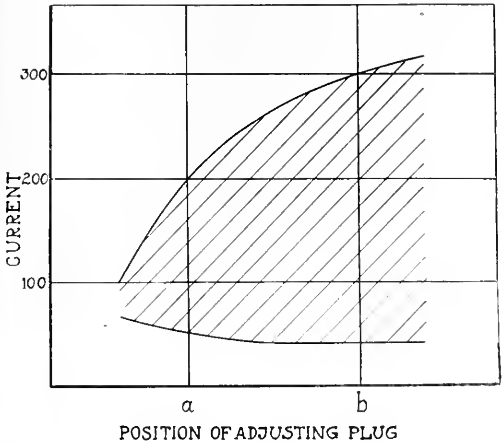


Fig. 2

the switch. For example, if the plug be at position "a," the switch will lock out at any current above 200 amperes but will definitely close as soon as the current falls to 200 amperes. Similarly, with the plug at position "b," the switch will lock out at any current value above 300 amperes, but will operate when the current falls to 300 amperes. The bottom of the shaded area indicates the minimum current at which the switch is operative although, of course, after the switch has once closed it will remain closed until the current has dropped to practically zero.

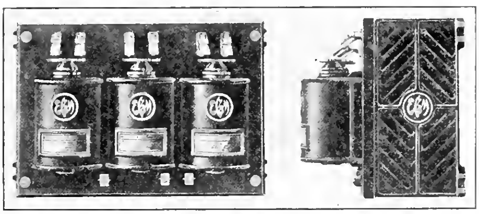


Fig. 3.

It will be apparent from what has been said descriptive of this switch (termed the type A switch) that its use is peculiarly suitable for motor starters. As a matter of fact the Electric Controller & Mfg. Co. has developed a complete line of motor starters embodying the use of the type A switch, these starters having been designated Type E. C. & M. automatic motor starters. They have been standardized for 110, 220 and 550 volts direct current current and over a wide range of horse powers. In order to make them as universally applicable as possible, the starters have been laid out in six different forms and, in addition, with various numbers

of the accelerating switches. The simplest form consists merely of a train of type A switches suitably mounted in connection with resistance, and the front and side views of such a starter are illustrated in Fig. 3. This starter is intended to be used in connection with a knife switch exterior to the starter. If it is desired to incorporate the knife switch in the starting panel this requirement can be met by the form illustrated in Fig. 4. Where push button or automatic

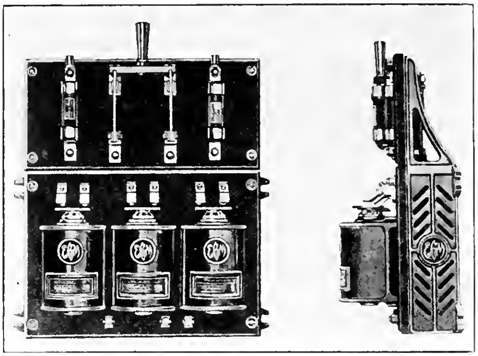


Fig. 4.

control is desired, and also preferably for large motors, a shunt wound magnetically operated switch is also incorporated; the appearance of this switch being depicted in Fig. 5. The starter including the type S magnetic switch, shown in Fig. 5, can be also equipped with an overload giving complete circuit breaker features and either of these modifications can be furnished with or without knife switches.

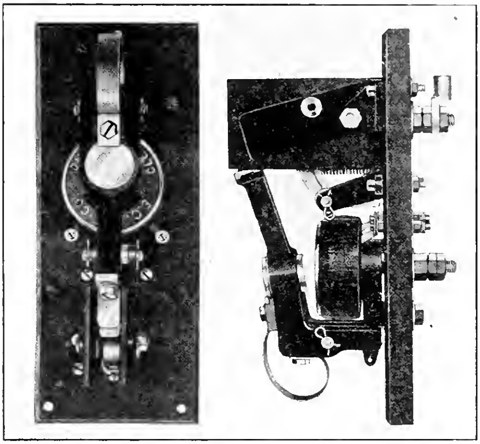


Fig. 5.

A complete line of accessories has also been developed, such, for instance, as would be required for automatic pressure regulation, maintenance of water level in water tanks, etc. The number of accelerating points which any particular starter will develop is one more than the number of accelerating switches used. For small motors where the load to be accelerated is light, one or two type A switches will be ample. On the other hand, for large motors, and particularly motors which have to accelerate heavy inertia loads, five or six type A switches should be selected.

Even the simplest form of the E. C. & M. automatic motor starter inherently provides no-voltage protection, for if the voltage fails, all of the switches at once drop out, inserting all of the starting resistance in series with the motor, and upon the return of voltage the motor is automatically accelerated in the normal method. With such a starter it is merely necessary to close the knife switch to start the motor and to open the knife switch to stop the motor. The acceleration of the motor is entirely automatic and will be accomplished in the shortest, safe time. If the load be light, the switches will close rapidly and bring the motor up to full speed in a short period of time. On the other hand, if the load to be accelerated be large, as for instance, if it be a punch press having a large fly wheel, the switches will close much more slowly and the time required to bring the motor to full speed will be considerably lengthened. In any event, however, the motor is accelerated to full speed in the shortest safe time.

This type of switch also finds a large application in controller work and the Electric Controller & Mfg. Co. is prepared to furnish it in connection with either reversing or non-reversing controllers for motors of practically any h.p. and of the common voltages.

CHINA'S FIRST REAL TELEPHONE SYSTEM NOW GIVING SERVICE.

A cablegram has been received by the Western Electric Company stating that the two telephone exchanges which it has been installing in the city of Peking, China, were successfully cut into service on April 2nd. These exchanges are both of the common battery type and each equipped for 6400 lines. At present 3000 subscribers' lines are connected to this telephone system, which is owned and operated by the Imperial Government.

There have been no adequate telephone facilities in China. The need for a telephone system became so apparent several years ago that an imperial commission was sent abroad to study the telephone systems of other countries. The commissioners were impressed with the facilities and service in New York City and recommended an equipment along similar lines for the Chinese capital. The contract was awarded to the Western Electric Company, after its system had been carefully compared with those of its competitors both in Europe and America. The cost of the original equipment is in the neighborhood of $150,000.

The new telephone system covers the whole of both the Tartar and Chinese cities. Underground cable, 3½ inches in diameter and containing 400 paper insulated wires, has been used. The telephone system will employ about thirty operators, all of whom will be Chinese girls. The foreign residents in Peking are particularly pleased with the arrangement of one section of each switchboard for their use. English speaking operators will be employed on these sections.

THE LARGEST STORAGE BATTERY IN THE WORLD.

A contract has just been made by the Consolidated Gas, Electric Light & Power Co. of Baltimore, Md., with The Electric Storage Battery Co. of Philadelphia, Pa., for the installation of an enormous battery to be used for emergency service. This battery will consist of 152 cells of the "Exide" type, each cell containing 133 plates. Each of the 152 lead lined wood tanks will measure 4 ft. 2 in, in height, 21¾ in. wide and 6 ft. 6⅞ in. long, and will weigh without plates or electrolyte 940 lbs. The total weight of the entire battery equipped with plates and electrolyte, when ready for service will be approximately 1,079,200 lbs. When fully charged it will supply sufficient electric current to light 120,000 twenty-five watt tungsten lamps for one hour or 240,000 such lamps for twenty minutes, having an output of 4000 h.p.

These huge emergency or "stand-by" storage batteries are used by the large electric lighting companies to provide

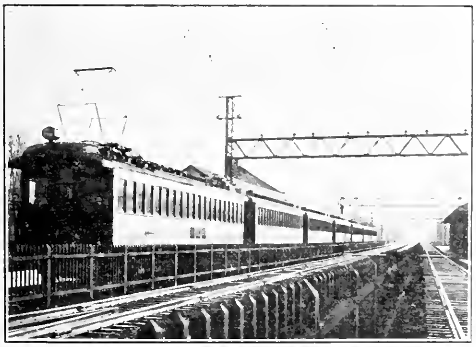
for unusual demands for current, caused sometimes by a temporary accident to electric generating machinery, or by sudden darkness preceding a thunderstorm, or as recently experienced in New York City by a heavy snow fall which within ten minutes increased the demand for current on the New York Edison Company's system from 100,000 to 166,000 h.p. In this case the rate of increase in current was so rapid that it was impossible to connect additional engines with sufficient rapidity, and the storage batteries were called upon to meet the emergency, thus saving New York City from darkness.

These batteries are popularly called "the watch dogs of the system" as they are instantly ready to supply enormous quantities of electricity, thus insuring electric light and power at all times and at the same time protecting electrical apparatus from sudden strains caused by large demands for current.

The Electric Storage Battery Company has installed 44 batteries for the New York Edison Company, many of which are almost as large as the one now being built for the Consolidated Gas, Electric Lighting & Power Company of Baltimore. Similar batteries have been supplied to the electric lighting companies in Chicago, Minneapolis, Brooklyn, Boston and Spokane, and many other large electric lighting companies, appreciating the protection from such batteries, are now considering an installation.

THE NEW YORK, NEW HAVEN & HARTFORD LEADS IN PUNCTUALITY.

One of the advantages claimed by advocates of electrification of main line roads is reliability of operation. It has been unofficially stated several times recently that the New York, New Haven & Hartford had practically no motive power delays in handling the entire passenger traffic of its New York end by Westinghouse electric locomotives and multiple unit trains, notwithstanding the change over from steam to electricity at Stanford.



N. Y., N. H. and H. Electric Train.

From reports of train operations in New York State during January, recently given out by the Public Service Commission, it appears that the New York, New Haven & Hartford made the best showing of any road in the State with 90 per cent of its trains on time.

The report is especially interesting in view of the fact that the New Haven is extending its single phase electrification to its Harlem division and another branch, and reported as planning extension to New Haven.

Of the roads entering New York City it is interesting to note that three of the electrically equipped roads, namely, the New Haven, Long Island and Pennsylvania stand high with 90, 86 and 84 per cent respectively.

A NEW LARGE HYDROELECTRIC PLANT FOR THE STATE OF OAXACA.

The Cia. Minera de Natividad y Anexas, one of the most active mining properties in the State of Oaxaca, located in the Sierra Juarez District, have recently purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., successors of G. & O. Braniff & Co., a new hydroelectric plant of 1000 h.p. capacity. The installation of this plant has been found necessary on account of the increasing output of the mine and for the proper milling and cyaniding of the ore to be handled.

The mining company already has a power plant which was installed many years ago but which was insufficient to meet the present demand and the company is now building a canal which will take the waters from the tail race of the old plant, and by using an available head of about 170 meters, can develop the 1000 h.p.

This new plant will comprise two 500 h.p. Pelton water wheels, which will be direct coupled to two 375 k.v.a. Westinghouse alternating current generators. The power house will also be equipped with two 15 k.w. exciters, each of sufficient capacity to excite both generators; also a large switchboard for control of the machines and out-going circuits. The transmission line will be about two miles long at 2400 volts, three-phase, and the power will be for motors in and about the mine and mill. This plant when completed will be one of the most modern in the country, and will be in full operation in a few months.

CELEBRATED TWENTY-FIFTH ANNIVERSARY.

Hugo Reisinger celebrated on April 1st the twenty-fifth anniversary of the establishment of his business as importer of carbons and other electrical supplies. The employes of the firm presented Mr. Reisinger with an artistic address bound in leather and silver with the signatures of the entire staff attached. Mr. Reisinger was the pioneer in the importation of lighting carbons to this country, and was the first to cause to be manufactured at the works of C. Conradty, Nuernberg, enclosed arc and flaming arc carbons. He is probably more thoroughly identified with the carbon and lamp business than any other dealer in America, and the trade mark "Electra" of his carbons is known to every one in the electrical field. Mr. Reisinger took a prominent part two years ago in the fight for a lower tariff on lighting carbons, and it was largely through his personal effort that the rate of $1.00 per hundred feet at first proposed in the new tariff bill was reduced to 65 cents. Mr. Reisinger suggested that 20 cents per hundred feet would be about fair, but it was impossible to push this reduction through. Outside of business Mr. Reisinger has devoted a great deal of time to art matters, and has promoted the exchange of works of art between America and Germany. He was honorary commissioner general for Europe to the World's Fair at St. Louis in 1904, has twice been decorated by the German Emperor and once by the Prince Regent of Bavaria. He is an active member of the New York Chamber of Commerce, and a director in many important companies.

E. C. Hutchinson of the Pelton Water Wheel Co. recently returned from a trip to Mexico taken in connection with the remodeling of a hydroelectric plant belonging to the Compania de Transmission Electrica de Cotoencia, which supplies electric current for the mines near Pachuca. The water wheels of the eleven generating sets, six of which were constructed by German engineers, will be replaced by Pelton wheels having an aggregate capacity of about 4000 kw. The main office of the electric company is in the City of Mexico.

NEWS NOTES

FINANCIAL.

BUTTE, MONT.—The Butte Electric Supply Company of Utah, capital $250,000, has been incorporated by E. E. Brazier et. al. This city will be the principal place of business.

DRAIN, ORE.—At the regular city election held at Drain the citizens voted bonds in the sum of $20,000. Of this amount $15,000 will be spent in installing a water system, while the remaining $5000 will be expended in laying sewers.

FALLS CITY, ORE.—Bids for the construction of the city water system have been received by the council as follows: Moffett Parker, Oregon City, $24,299.20; K. Lancher, Corvallis, $24,200; H. Benske, Portland, $23,524.20; The John Contracting Company, $21,206.

PALO ALTO, CAL.—Palo Alto has voted strongly in favor of the issue of $50,500 worth of municipal bonds to extend the policy of city ownership. Only two out of the seven separate issues voted on were defeated, one of these being a proposition to expend $20,000 in building a spur track to the municipal lighting plant and the other being an item of $2500 for a city jail. The measures favored were: An auxiliary pumping plant, $2000; a steam conductor and water cooler at the municipal water-works; a concrete building for the municipal lighting plant, $20,000; a garbage incinerator, $15,000, and an automobile fire engine, $6000.

ILLUMINATION.

UKIAH, CAL.—The Supervisors have passed an ordinance granting the Ukiah Gas Company a franchise to construct its lines, etc., in Ukiah.

YUBA CITY, CAL.—It is proposed to form a new lighting district to comprise most of the town of Live Oak, and an election has been called for April 24.

PORT TOWNSEND, WASH.—The Western Steel Corporation has made application to the Board of Commissioners for a franchise for the use of certain streets in Irondale for lighting purposes.

RED BLUFF, CAL.—Superintendent Charles Hughes of the Northern California Power Company, announces that the company will immediately begin the extension and improvement in its gas system in this city.

MADERA, CAL.—A canvass is being made of the town with a view to the installation of a gas plant here, and if 400 citizens will sign up to use the gas either for lighting or heating purposes, a plant will be installed.

DORRIS, CAL.—A special meeting of the Town Board of Trustees will be called in a few days to consider a franchise, applied for by the Siskiyou Light & Power Company of Yreka, to furnish Dorris with electric power.

STOCKTON, CAL.—The West Coast Electric Battery Company, manufacturers of individual low voltage storage battery electric light and power plants, has opened Stockton offices in charge of F. P. Davis as general manager.

CHICO, CAL.—Chico will soon have a conduit system in the business section of the city for the power, light, telephone and telegraph wires. The Pacific Gas & Electric Company and the Sacramento Valley Power Company are waiting the arrival of material for the conduit system. Work will begin during April or early in May.

CLAREMONT, CAL.—The City Council has passed an ordinance granting to the Pacific Light & Power Corporation a 50-year franchise to erect poles and string wires for electrical purposes along Mills avenue from N. First to north of the city limits.

LAKEPORT, CAL.—J. A. Foster and J. L. Davis, have made application to the Board of Trustees for the granting of a franchise to erect and maintain poles upon the public streets, roads, highways, avenues, bridges and alleys, in the town of Lakeport.

CHEHALIS, WASH.—The Council has passed an ordinance granting to the Twin City Light & Traction Company a new light and power franchise. They will begin work at once on their new power house, the cost of which is estimated at $75,000, to be located on Coal Creek.

BERKELEY, CAL.—The attempt of the Council to permit the people to fix their own water and electric rates met a setback this week, when, following the action of the People's Water Company in serving a writ of mandate on City Clerk Walter Sanborn to prevent him from placing an initiative ordinance on the city ballot at the election April 22, the Oakland Gas, Light & Heat Company took similar action.

QUINCY, CAL.—Harold R. Ebright of San Francisco has deeded to the Oro Water, Light & Power Company water rights aggregating 60,000 inches of the water of four creeks flowing into the north fork of the Feather River. The water in the reservoir will be carried in ditches and pipes from the reservoir to a point where a plant will be constructed on the bank of the Feather River near the mouth of Yellow Creek.

EUREKA, CAL.—The holdings of the Arcata Lighting Company have been officially taken over by the Western States Gas & Electric Company, negotiations for the purchase of the lighting and power distributing system having been closed several days ago. For the present, at least, there will be no changes made in the working force of the Arcata system while the plant will be continued to be conducted as heretofore.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company has announced a sliding scale reduction in lighting rates in the business district of Marysville. To get the benefit of the reduction the Marysville merchant must install a meter, and use more than $7.50 worth of current in a month. On monthly bills ranging from $7.50 to $150 the rate becomes smaller as the amount of current consumed increases, the maximum being 8c per kw. hour and the minimum 3c per kw. hour.

SACRAMENTO, CAL.—A new light and power company, to be known as the Citizens' Light & Power Company, is to be established in Sacramento, financial backing to be furnished by local capitalists, including George W. Peltier and the Fleishhacker interests of San Francisco. The new concern will have an authorized capital of $2,500,000 and may issue bonds for a like amount. The plant will be put in operation this fall, and will start with the distribution of the power from the Great Western Company. A steam plant will be erected as a secondary electric supply for the winter months to insure continuous service.

PORTLAND, ORE.—A resolution has been passed by the City Council of Portland to extend for one year, or until July 1, 1912, the time in which the Portland Railway, Light

& Power Company is required to equip all of its cars with automatic fenders in accordance with the provisions of the ordinance passed by the Council in the fall of 1910.

PHOENIX, ARIZ.—The Phoenix Railway is now building a new substation in Phoenix. The machinery to be installed will consist of a 100 kw. motor generator set with transformers, oil switches, switchboards and necessary auxiliary apparatus.

BISHOP, CAL.—The Owens River Valley Electric Railway Company advises it will build a 4½-mile electric railway to connect Bishop and Laws, and extending to Round Valley, a distance of 12 miles. The company will purchase power. Harry Shaw of Bishop is president, Curtis Hillyer, San Francisco, secretary and treasurer, and Raymond Spaulding, Bishop, chief engineer.

OAKLAND, CAL.—Plans for a half million dollar improvement of the electric lighting system of the Oakland Gas, Light & Heat Company, have been practically completed. Because of the rapid growth of the city and the increased demand, the power plant of the corporation is said to be getting more and more inadequate to meet the needs of the company. Recently a contract was signed by officers of the company for the installation of a 20,000 h.p. of 16,000 kilowatts electric turbo-generator. The installation of this generator will require the use of 10,000 extra boiler power. This will practically double the present capacity of the electric plant of the company. Frank A. Leach Jr., president of the Oakland Gas, Light & Heat Company, says that the additional machinery will probably be operating by November. The turbogenerator will cost approximately $500,000 when installed.

MARYSVILLE, CAL.—Paul Downing, the engineer of electrical construction of the Pacific Gas & Electric Company, who has been making a tour of inspection of the company's several large electric plants and its main transmission lines, states that the present flume and ditch system carrying water for eight miles around the sides of a mountain to reach the Colgate plant east of here is to be abandoned. Instead a big tunnel will be pushed through the mountain. It will be an expensive undertaking in building, but inexpensive in operation and repair. Just when the work will be commenced is not yet decided. Another improvement to be made is the substantial steel towers for the present poles on the main transmission lines from Colgate to San Francisco bay. This also will be an expensive work, but will soon pay for itself in reducing operating and repair expenses, and in continuity of service. All the main distributing lines will eventually be carried on these towers.

LOS ANGELES, CAL.—The Southern California Gas Company will not be granted a blanket franchise for Los Angeles County by the Board of Supervisors. E. O. Edgerton, secretary of the Municipal League has lodged a vigorous protest against it. The Board will deny the application of the corporation without prejudice. This will then permit the gas company to obtain a franchise covering certain specified sections of Los Angeles County. The company has applied for a 50-year blanket franchise. The board held the matter up some time ago and desired to reduce the period to 40 years. A protest was made by representatives of the company. One of the reasons why the Board of Supervisors will refuse to grant the blanket franchise is that to do so will will mean the elimination of all competition in the county. Supervisor Butler stated that if the Board did so the smaller gas corporation would not enter into new fields, because the larger and more powerful corporation would immediately get into competition with it. The damage to county roads built under the good roads project is also an argument against granting the franchise, according to Mr. Butler.

time will be consumed in the run to Woodbridge. Lodi will be greatly benefited by the addition of the new road.

OREGON CITY, ORE.—Officials of the Canby Canal Company are interested in the plan to construct an electric railway from Canby to Molalla, with feeders extending to Beaver Creek, Meadowbrook, Colton, Needy and Macksburg. There is a possibility that the road will cross the Willamette River and connect with the Oregon Electric near Wilsonville.

PHOENIX, ARIZ.—Superintendent S. H. Mitchell is progressing rapidly with the improvement of the Phoenix street railways. Poles and wire are upon the Glendale line as far as Central avenue and will be completed to the end of the line in Glendale within 10 days. Two other lines, which are likely to be commenced soon are the Ingleside and the Scottsdale, and an important south side line on Central avenue, across the new bridge and through Tempe to Mesa.

MONTEREY, CAL.—The broad gauging and reconstruction of the track of the Monterey & Pacific Grove Electric Railway has begun. One block will be done at a time, in order to keep the cars running it will be necessary to lay a temporary third rail. The ties are to be set in concrete. A couple of the best cars will be rebuilt, and other rolling stock will be purchased in the East. As soon as the road can be broad gauged the equipment will be modern and up-to-date in all particulars.

TRANSMISSION.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company is preparing to extend its lines from Cottonwood to Vollmer and Ilo, work to start at once.

CENTRALIA, WASH.—A bond in the sum of $10,000 was deposited by the Twin City Light & Traction Company, guaranteeing the erection of a new power plant on Coal Creek.

CULVER, ORE.—The Cove Power Company has begun construction of a power plant on the Crooked River, two miles west of Culver. Brown & Van Valkenburg have contracts for a large part of the work.

CASTLEROCK, WASH.—Collins & Everly are engaged in developing a power project on Toutle River, eight miles from here on the Tower road. They expect to generate 1000 h p. and will take six months to complete.

JACKSON, CAL.—Leopold D. Caminetti has located 20,000 inches of water from the Mokelumne River five miles west of this city. The water is to be used to furnish power to generate electricity. The location is in Rocky Canyon.

REDDING, CAL.—The Northern California Power Company has started work on its new power line from Hamilton to Princeton. This line connects with the 60,000 voltage transmission line, which has already been carried into Hamilton and it will be extended to Arbuckle as rapidly as possible.

WALLA WALLA, WASH.—The Pacific Power & Light Company announces that it will start the construction of a transmission line from Walla Walla to Dayton by way of Dixie, Prescott and Waitsburg. The line will cost $50,000.

SONORA, CAL.—The Tuolumne River Power Company, a Maine and California corporation, has transferred its holdings in Tuolumne County, to the Yosemite Power Company. The Tuolumne River Power Company, which has been sold, included a large tract of timber land, 65 miles of water ditch, water rights, power sites and irrigation rights on the Tuolumne River, and it was sold for approximately $650,000.

TRANSPORTATION.

OAKLAND, CAL.—The Oakland, Antioch & Eastern Railroad has made application for a franchise in Shafter avenue, from Rock Ridge to Fortieth street.

PASADENA, CAL. The Pacific Electric Railway Company has announced that beginning at once the California street line will be double-tracked for its entire length.

TURLOCK, CAL.—S. N. Griffith has made application to the Board of Trustees for a 50-year franchise to construct and operate a single track street railway in the city of Turlock.

TWIN FALLS, IDAHO.—Negotiations have been entered into by W. L. Cherry and associates for the purchase of ties and rails for the construction of an interurban railway from this place to the Snake river canyon, to be built this summer.

BELLINGHAM, WASH.—Leslie R. Coffin of the Whatcom County Railway & Light Company has submitted plans and designs to the Stone & Webster officials for the new electric interurban cars to be used on the Bellingham-Skagit interurban.

ELLENSBURG, WASH. Paul L. Richards has applied to the County Commissioners for the right to construct and operate an electric motor line railway system in Kittitas County. May 1, at 1 p. m. has been set as time when the board will hear the application.

LODI, CAL. The California Traction Company will commence work immediately upon the extension of its road from Lodi to Woodbridge. The plan is to have the road in working order in time to handle this year's grape crop. As soon as the line is completed the passenger service to Woodbridge will be in order. At present the cars running between here and Stockton are obliged to remain here 15 minutes, which

TELEPHONE AND TELEGRAPH.

UKIAH, CAL.—J. A. Cuminsky has applied for a telephone franchise in this city.

PALOUSE, WASH.—The Interstate Telephone Company announces that a telephone system to cost $20,000 will be installed in this district.

DAYTON, WASH.—The County Commissioners have granted a franchise to the Mount Vernon Telephone Company to construct and operate a rural telephone line from this place to a point near the Wenaha forest reserve.

VICTORIA, WASH.—The British Columbia Telephone Company will soon increase its telephone service here by ordering about 900 additional telephones. An underground distributing system will be installed and other improvements made.

NAPA, CAL.—Supervisor W. Casey and other taxpayers of Browns Valley precinct have filed with the Board a petition for permission to construct a telephone line, beginning at a point on First street and running westerly along the south line of the county road one mile.

SUSANVILLE, CAL.—The Johnstonville Telephone Company has applied for a franchise to erect, construct and maintain poles and wires along streets, alleys, avenues, and highways, for a general telephone business in this town. Sealed bids will be received up to 8 p. m., May 29th, 1911, for the sale of the franchise, to R. E. Bangham, Clerk.

PASADENA, CAL.—President A. B. Cass of the Home Telephone Company announced that his company will erect a $30,000 power plant on the east bank of Arroyo Seco, and will install telephones for about 300 residents. South Pasadena will then be the center of distribution for Pasadena, San Gabriel, Alhambra, Eagle Rock and part of Garvanzia.

WATERWORKS.

LEMOORE, CAL.—Marshal Dickenson has been ordered to have new mains laid along Bush street and Lemoore avenue.

SILVERTON, ORE.—The Mars Construction Company of Seattle has been awarded the contract for the construction of water and sewer systems for Silverton.

MARSHFIELD, ORE.—Plans for a joint water system for North Bend and Marshfield with estimates of probable cost, are being prepared by J. L. Stannard of Stannard & Richardson, of Portland.

SNOHOMISH, WASH.—The City Council has let a contract for the building of 16 miles of gravity water mains to supply the city with water, to the Atlas Construction Company of Everett, whose bid was $83,250.

MANTECA, ORE.—A contract has been signed between the Manteca Improvement Company and A. Bacillieri which provides for a complete water-works system for domestic and fire protection to be installed at once.

FRESHWATER, ORE.—Mr. G. Jaeger of Rich Hill, Mo., who has also an office in Chicago and Kansas City, arrived here last week and made preparations to start work on the water-works, the contract for which was let last December.

SUISUN, CAL.—At the meeting of the Board of Trustees of Fairfield last week the new water rate was passed. It allows the Fairfield Water Company to place meters where desired, the cost of the meter to be borne by the consumer.

SPOKANE, WASH.—R. A. Hutchinson, Elmer E. Hall and William S. Lewis, of Spokane, Wash., have filed a petition asking for a franchise from Spokane county for a period of 25 years, to lay water mains and operate a water system in and along the streets of Woodlawn Park Addition, Spark's Addition, Central Park Addition, and upon Sprague, First, Second, Third, Fourth, Fifth, Sixth, Seventh, Hartson, Eighth, Ninth, Tenth, Eleventh and Twelfth avenues.

SAN FRANCISCO, CAL.—The water rates committee of the Supervisors has requested the city water inspector to furnish a list of all localities in the city in which the Spring Valley Company has refused to lay water mains, or where its mains are inadequate to supply the residents of the district. This step is taken with the intention of bringing a suit to test the powers of the municipality to force the water-company to provide water to every part of the city and to extend its mains for that purpose. Heretofore the Spring Valley Company has refused to spend any money in extending its service in the growing districts, making the excuse that the income allowed by the rates was not sufficient to warrant the investment.

BERKELEY, CAL.—Initial steps toward the reduction of light and water rates in this city have been taken by the City Council, Councilman McClure taking up insistent demands from citizens that the rates now in effect be reduced, either through the establishment of a municipally owned light plant or through agreement with the public-service corporations. The Council also authorized a payment from the city funds of a sum of $1000 annually for representation on the San Francisco Engineers' Commission investigating the proposed improvement to the bay cities water supplies, including an examination of the Hetch Hetchy and Sierra supplies, with a view to enlargements to the services now being furnished in the cities of San Francisco, Oakland, Alameda and Berkeley. The conference committee of the allied improvement clubs of Berkeley has asked for a reduction in the price of water from $1.50 to $1; lights from 9c to 7c and gas from $1 to 90c.

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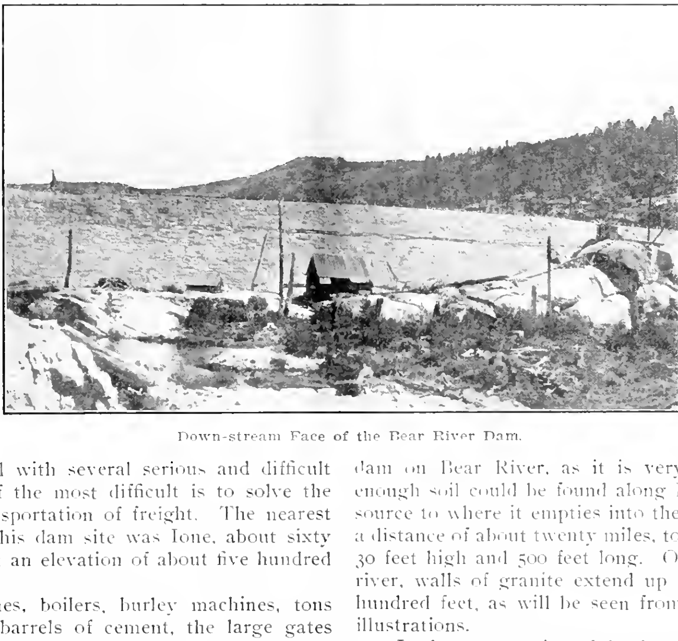
THE BEAR RIVER RESERVOIR

BY WILL T. JONES.[1]

Nestled in the high Sierra Nevada mountains, in the eastern part of Amador County, 6000 feet above the level of the sea, and surrounded by massive walls of superb granite, lies the Bear River reservoir or lake, which is one of the places in which water is stored during the spring of each year, to be used in the operation of the Electra power house during the late summer months and for furnishing water for the mines and for domestic and irrigating purposes in Amador County.

The Standard Electric Company realizing the necessity of ample storage to tide them over the dry season each year, decided upon building a dam across a small meadow through which Bear River runs, and in 1900 active operations were commenced. To build a large storage dam in an isolated section of California, such as this location, a company is confronted with several serious and difficult problems. One of the most difficult is to solve the matter of the transportation of freight. The nearest railroad point to this dam site was Ione, about sixty miles away, and at an elevation of about five hundred feet.

Donkey engines, boilers, burley machines, tons of giant powder, barrels of cement, the large gates and pipes, oakum, nails, blacksmith supplies, boarding house and commissary supplies, in fact everything necessary to equip and maintain a camp where from one hundred to one hundred and fifty men were to be employed, had to be hauled this entire distance. Ten and twelve-mule teams were pressed into service, and a team would make a trip every eight to ten days. There was a continual up-grade from the time Ione was left until within five or six miles of Bear River, when a descent of five hundred feet is made. Still, with this great distance to haul all material over such a rough road, the records show that everything arrived on time and the work was never held up on that account.

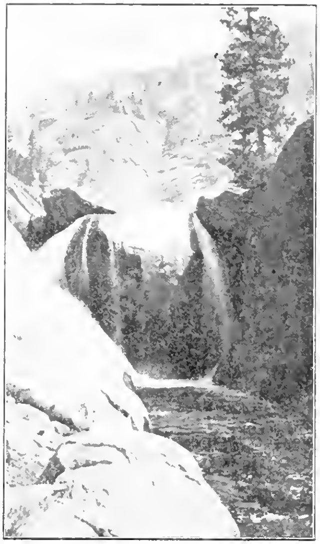


Down-stream Face of the Bear River Dam.

At this time the old earth dams, which were practically the only ones constructed previously, were giving away to the more modern stone dams, so the dam at Bear River was built entirely of granite. It might be added that there was not much choice between the earth-fill dam and the stone dam on Bear River, as it is very doubtful whether enough soil could be found along Bear River from its source to where it empties into the Mokelumne River, a distance of about twenty miles, to build an earth dam 30 feet high and 500 feet long. On either side of the river, walls of granite extend up into the air several hundred feet, as will be seen from the accompanying illustrations.

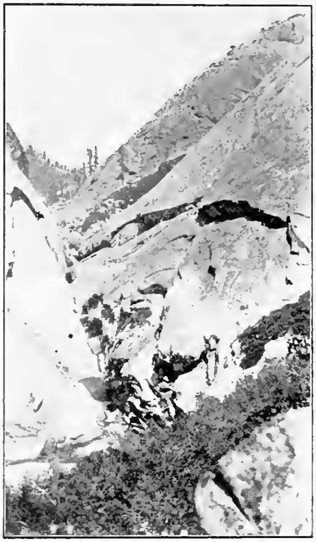
In the construction of the dam two donkey engines were used to place the rocks, while a third donkey loaded the cars in the quarry. Steam was the motive power used to run the burleys, the machines being mounted on tripods. Several holes drilled in the granite walls were filled with ten to forty boxes of giant

[1]Operating and Maintenance Department Pacific Gas & Electric Company.



Five Miles Down-Stream from the Dam

Outlet of Bear River Reservoir.



On Bear River Four Miles Below the Dam

powder, and fired at once by electric exploders operated by batteries. When this charge was let off, thousands of tons of granite were thrown down, the largest pieces blasted again, then loaded on the car and started for the dam. Some of the rocks placed in this dam weigh ten tons each and it was necessary for both engines to place them in the wall.

The dam is 800 feet long on top while at the bottom it is only 200 feet. It is 120 feet wide at the base, 10 feet wide on top, and about 60 feet high. The rocks were laid at a 2-to-1 batter. On the inside of the dam, and set in the rocks at intervals of every ten feet, 12x12 timbers were placed, and to these were nailed double rows of 3x6 native pine, each row being caulked with oakum and so laid that the outside layer of boards overlapped all the joints and cracks in the inside layer. In this manner the leakage was reduced to a minimum. The life of this lining is placed at from twenty to thirty years.

To furnish the lumber necessary for the construction of the dam and for erection of the various buildings for the camp, such as boarding and sleeping houses, barns, etc., the company built a sawmill on Little Bear River, a distance of three or four miles from the dam, and all the lumber had to be hauled this distance. The mill was located in one of the prettiest groves of timber that is in the State of California today. In driving through this grove one is awed by the immense number and the giant size and towering height of these magnificent trees. The writer secured a snap shot of a giant sugar pine which is located in this section. This tree is ten feet in diameter and at least 200 feet high. This grove is composed of sugar pine, yellow pine, fir, spruce and tamarack, so that the matter of securing the necessary timbers for the dam was a simple matter after the sawmill was erected.

The reservoir was completed in the year of 1902, but the winter of 1902-1903 showed the necessity of a larger spillway, so in the fall of 1903 the spillway was enlarged until it is now 80 feet wide and 5 feet deep.

When the reservoir is full it covers an area of about 130 acres, and the water is backed up a distance of 1⅛ miles. During some of the spring storms there is 4½ feet of water running over the spillway, mildly illustrating that where a thousand gallons of water is stored today, a million, yes, ten million, might be stored and used to beautify the fertile valleys of the San Joaquin instead of being allowed to flood them in the winter time.

A tunnel about one hundred feet long, running through solid granite, taps the bottom of the reservoir. The water finds an outlet through three pipes leading through this tunnel, each pipe being fitted with a heavy gate capable of carrying about 1000 inches of water.

The Bear River reservoir is the first to be drawn from each season, and after about ten or fifteen feet of water is drawn out, the gates are closed and the balance of the water is held until the close of the dry season, when it is drawn, provided it is needed. Telephone communication with Electra is kept open the year round with the possible exception of a few days in severe storms, and this is remarkable, considering the fact that some years they have as much as fourteen feet of snow on the flats. In the meantime storage water is drawn from the Blue Lakes, which are located about forty miles further east. In the late fall, especially after a severe storm, the telephone line usually goes down between Bear River and the Lakes, hence the advisability of holding the water in Bear River reservoir until the end of the season. Sometimes a storm in the Fall will develop sufficient water for all purposes, and the storage water being ordered off, after a day or so the water might fail again, and with the telephone to the Lakes out of order, it is a simple matter to have Bear River open up. This water reaches the head of the ditch a great deal sooner than it would from the Lakes.

TRANSMISSION SYSTEMS FROM THE OPERATING STANDPOINT.[1]

BY R. J. C. WOOD.

Requirements.

In order that a transmission system may satisfy the operating engineer it should fulfill the following conditions:

1. The requisite amount of power must be transmitted with reasonable voltage regulation.
2. Interruptions must be reduced to a minimum.
3. Flexibility of operation should be assured.
4. Ease of repair is essential.

Regulation.

The voltage to be used is chiefly, if not entirely, determined by economic conditions. It is as easy to operate with 60,000 volts as 15,000; indeed, there seem to be more short circuits and troubles on the lower voltage lines probably because of the less careful construction used and the lesser absolute insulation margin allowed. We hear from the lines operating above 100,000 volts that they encounter no greater difficulties than do those of lesser potentials.

Up to distances of about 150 miles (241- km.) frequency is not a very vital matter. An increase in voltage will offset the difference in regulation between 25 and 50 or 60 cycles. This factor will be decided by the relative importance of the classes of load demanding either high or low periodicity, so as to make the total cost a minimum, and the consumers' satisfaction a maximum.

There are various formulas for calculating regulation, and it is not necessary to refer to them in detail, beyond remarking that the conditions surrounding the delivery of power are often somewhat indeterminate. The power factor of the load, for instance, is often not to be foreseen between wide limits. This uncertainty renders abortive any extreme accuracy of method as applied to calculating the line.

It will be immaterial, therefore, when considering moderate distances up to 150 miles (241 km.), whether a formula is used, based upon the capacity being all at the center, part at the ends, or uniformly distributed over the line.

The allowable drop of voltage will depend upon conditions. Where power is transmitted in a block from the point of generation to a center of distribution, the regulation may be as high as 25 per cent. In such a case the voltage drop will probably be limited by the value of the lost power rather than by any operating difficulties.

The nature of the load will also bear upon the allowable voltage fluctuations. A mixed light and power load will demand closer regulation than either class of load by itself. If the service is all power a certain unsteadiness of voltage is allowable and if it is all light the changes in load will come on in such a manner that the operator can follow them by hand regulation.

When, however, the transmission line is part of an interconnected network and may have to transmit in either direction, then the regulation must be low in order to keep within the range of the regulating devices used in substations. If, for instance, a hydroelectric and a steam plant are at opposite ends of the line and there are numerous substations between the two, the flow of power may be either way.

Most probably the important center of distribution will be where the steam plant is located, and the voltage must be kept uniform at this end. The voltage at substations along the line will then vary by an amount equal to double the regulation of the line.

This fluctuation can be entirely eliminated from the distributing circuits by using automatic regulators, but the main transmission line should only have one-half the regulation that would be permissible were it a straight one-way transmission.

In loop or ring systems, fed from both ends, the circuit must be heavy enough to permit of feeding the entire load, all around the loop, from either end. If this is not the case it will be found that when certain sections of line have to be cut out for inspection or repairs, the open end of the loop does not get satisfactory service.

The amount of power that should be carried on a single circuit bears a relation to the total power of the system, the importance of certain loads, and the balance that the management draws between insurance against loss of revenue and prestige, and investment costs.

It will probably be wise in systems of 60,000 volts and above to confine the capacity of each circuit to 100 amperes. Baum has shown that the surge voltage, due to sudden interruption, is equal to 200 times the amperes, so that in the above case there would be a rise of 40,000 volts when a circuit breaker went out, supposing it to be open at double normal current. This would give a total voltage of 100,000 when superimposed upon a 60,000-volt line. Line and transformer insulation would stand this momentarily.

In order to deliver uniform voltage to the consumer, a variety of automatic and non-automatic devices are in use. It is questionable whether automatic regulation is desirable at the generating station, unless a type of regulator is used that will discriminate between the drop of voltage, due to increasing load, the drop occasioned by extreme overload, and that due to short circuit.

There are these three conditions to be met. Regulation for variations of load is comparatively simple, but when, due to troubles on the line, certain generating plants get left with more than their share of the load, we need a regulator that will discriminate and lower the voltage to a point where the generators will carry a safe current. Again, if a dead short circuit occurs on the line, the regulator must automatically lower the voltage as much as possible so that the arc may break; it should also, as soon as the line clears up, proceed to slowly build up the voltage to normal. It is too much, perhaps, to ask all this of an inanimate

[1]Paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Los Angeles, April 25-28, 1911.

device, besides which it might deprive the switchboard operator of his job.

If synchronous apparatus is in use at the receiving end of the line, an automatic regulator controlling its field is quite feasible and should give excellent results. It entails, however, the fixed charges upon a considerable investment and certain operating expenses. Distributing feeders from substations along the line can be automatically regulated by the various types of induction regulators.

Reliability.

Second only to the ability to transmit with reasonable voltage drop is freedom from interruption. To insure continuous operation we must have first class mechanical construction in line and substations. In designing the line we may take the worst climatic conditions on record over at least 30 years and then allow a factor of safety of 2½. This would give a limiting unit tensile stress of 22,000 lb. for copper and steel, and 10,000 lb. for aluminum. Compressive stresses in towers to be reduced by column formulas. The tower should in any case be strong enough to stand the unbalanced stresses produced by the failure of one conductor.

The stress upon pin type insulators may be limited by designing the tie wires to break at the unbalanced stress above mentioned. It is better in case of some catastrophe to a tower, or line, to have the conductors break the ties, than to pull over a succession of towers. To attempt to design a tower that will stand the total breaking stress of all the conductors, leads to economic impossibilities. The transmission should preferably be on a private right of way which should be cleared of trees and brush.

With sufficient spacing of conductors from each other and from the tower structure itself, and with insulators tested to 3½ times the voltage to neutral for grounded Y, and 3½ times line voltage for undergrounded delta systems, there should be no interruptions except those caused by lightning or malicious interference.

The requisite clearance between conductors and tower structure is sometimes underestimated; in certain parts of the country large birds will roost upon the tower. If the insulator is of the pin type they consider it a most excellent device to get under. All goes well until about 4 a. m. in summer time, when the bird wakes up, stretches, and grounds the line. The suspension insulator should be free from this trouble, provided there is enough space between the conductor and the cross arm below it.

To minimize lightning troubles all kinds of arresters have been used as well as ground wires. Ground wires seem to do no harm and in many cases have without doubt prevented trouble. They give an added stiffness to the line mechanically, and are a wise precaution to install in sections habitually subject to storms. So far no arrester is perfect, most or all of them will burn up at times, even the electrolytic type is at times untrustworthy upon delta-connected high-potential systems. The only consolation the operator derives, when his arresters burn up, is the thought that perhaps they saved something more valuable. The most robust type is the horn gap, it needs lots of space to accommodate the power arc that follows a discharge, and it usually shuts the system down when it goes off, but other types sometimes do the same.

It may become necessary to put in, say, electrolytic arresters to take care of the surges, due to switching and minor climatic disturbances, and then protect these arresters with horn gaps, if this be possible, to take the irresistible discharges from heavy lightning, which would cause temporary interruption in any case. When lightning causes a disturbance on the line, the surge will usually not travel far, but will break over an insulator, the arc formed will in many cases break the insulator, due to the intense heat. Ring guards at top and bottom of the insulator have given excellent protection to the insulator, by carrying the arc away from its immediate neighborhood.

The choice of supporting structures will generally lie between steel towers and steel or concrete poles. From some preliminary estimates that have been made it would appear that reinforced concrete poles for long span work will be extremely costly.

Where the districts fed from the line are scattered over considerable territory the transmission will have to be laid out either on a radial or loop system. The loop or ring system has the advantage of giving each substation a source of supply over entirely different routes, which are not both liable to be out of commission at the same time.

If the loop is double circuited throughout, the substations may be divided between the two circuits. Normally, the loop will be open at about its center, being fed from both ends. In case of trouble the circuit breakers at the feeding ends will open up and cut out only about one-fourth of the stations connected. These stations will at once switch over to the good line. The opening in the loop will only be closed under emergency conditions.

The radial system necessitates double circuits on all branches if full protection is to be afforded, and for the same insurance against interruption is more costly than the loop arrangement.

As already incidentally mentioned it will be necessary to have relays and circuit breakers installed upon branch circuits so as to isolate trouble. There does not seem to be any reliable way to automatically cut out the faulty line when one of two circuits, in parallel at both ends, becomes short circuited or grounded. We have had some success when generating at both ends of a two-circuit line. With the inverse time type of relays the faulty line has been cut out automatically at both ends in a great many cases. If generating at one end only then both lines will go out. We need very badly a reliable reverse current relay that will operate at zero voltage.

Any growing system will suffer sooner or later from an inadequacy in its switching devices. Switches that operated perfectly when the total generating capacity was small, will fail more and more frequently to handle the short circuit as the total kilowatt capacity increases.

It will be found that there is no room for the larger switches that should replace the original installation. It is almost impossible to have too much space in the

switch galleries and bus bar compartments, and economy of space here, while it may have been attractive and looked all right when the plant was young, is all the same a false economy. The lack of a few extra feet between switches might lead to an entirely new lay out being required in a few years. It is becoming the practice to install additional reactances in generator circuits to limit the short circuit current of large systems. It seems a pity to have to do this and spoil the regulation of the machines to the point where auxiliary automatic regulating devices are essential. It is a question whether such immense systems should not be normally cut apart into sections of perhaps 50,000 kw. capacity. This would simplify operation and localize trouble.

Even in smaller systems, normally operating as a unit, it is necessary to have points where they can be instantly cut apart, leaving certain loads on certain generating stations. This is the operator's first move when short circuits occur; to separate the several sections so that the greater part of the system may suffer as short a time as possible. If all important transmission lines were built with at least three circuits then they would be self clearing, using only inverse time relays at both ends. It is, however, often difficult to get the money to build three lines where two will apparently suffice.

Too much complication in providing for all imaginable combinations of switching is to be avoided as defeating its own object, which should be to keep the customer supplied with energy as continuously as possible. When the operator has to stop and figure out what to do next in cases of trouble, precious moments are being lost. To insure prompt operation a good telephone line is a necessity and the money will be well spent in building an independent pole line for its use. A telephone line running upon the same towers with the transmission lines is very likely to be inoperative just when it is most needed.

It is perhaps possible to formulate a set of rules, so that each station in a network knows exactly what to do under all conditions, but a word from the load dispatcher is worth many rules in the book.

Repairs.

There should be sufficient circuits and switching facilities so that all sections of the line may be cut out for inspection or repairs. It is an added precaution to have ground clips on all line disconnecting switches, so that when a line is killed with the object of working upon it, it is also grounded at both ends.

Long transmission lines should be sectionalized so that it is never necessary to cut out more than a fraction of the line at any one time. By having switching stations a convenient distance apart they also serve as resting places for the patrolmen. Circuits should also be so arranged upon the towers or poles that men may work upon it without getting into dangerous proximity to the other circuits which will be alive.

Conclusions.

All the foregoing requirements are summed up in which might be as good a motto for the operating engineer as for the system he operates, namely: capability, reliability, flexibility and repairability.

THE REFINING OF IRON AND STEEL IN INDUCTION TYPE FURNACES.[1]

BY C. F. ELWELL.

Electrical Features.

The furnaces for the refining of steel electrically, which have passed the experimental stage, may be divided into two distinct groups, viz., arc furnaces and induction furnaces.

To the former belong the Heroult, Stassano, Keller and Girod furnaces, and to the latter the Kjellin and Rochling-Rodenhauser furnaces. Of the former the Heroult furnace is perhaps the best known and most successful and as comparison always carries more weight than a description, it will be used as the representative of the arc furnaces. The electrical features may be divided up under several heads.

Distribution of Heating Effect of the Current.

Arc Furnaces. In the Heroult furnace the current passes from one electrode through an arc to the slag, through the slag to the upper metal and thence through another arc to another electrode, and of the current which passes through the carbons only a small percentage passes through part of the metal. As the heating effect of the arc is far greater than any effect of the resistance of the charge, there must be large differences of temperature between different parts of the bath of metal even in spite of the great activity of the bath around the electrodes. This is especially the case with a deep bath of metal. It is for this reason that Girod employs a bottom electrode, thinking thus to have these differences of temperature less by passing all the current for the arcs through the bath. From figures given in Stahl and Eisen for a two-ton Girod furnace, it was computed that the resistance of the carbon electrode was 3800 times that of the bath of metal and so 3800 times more electrical energy was converted into heat in the carbon electrode than in the bath itself. From this it is seen that if the current in the bath of metal produces any considerable part of the heat of the furnace, there must be a large loss of energy in the carbon electrode. The only correction for this is to make the electrodes larger, and the working limit has already been reached. The fact is that the bath is very little heated by the passage of the current and almost all the heating in this type of furnace is done by the very localized heating of the arc The matter of the losses of energy in the carbons will be taken up under the heading of efficiency.

Induction Furnaces. The principle of the induction furnace is already well known to you but in order to compare the Kjellin and Rochling-Rodenhauser types it will be well to repeat briefly the principle of operation and the type of construction of the Kjellin type. The furnace consists essentially of an iron core around one leg of which is wound a primary winding enclosed in a refractory case and usually cooled by means of forced draught. The annular hearth surrounds this primary coil and is separated from it by means of refractory material. This hearth contains the metal and acts as a secondary winding of one turn. The voltage induced in this turn is quite small so that

[1]Paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Los Angeles, April 25-28, 1911.

the energy transformed from the primary coil results in a very large current in the secondary, which heats the metal and thus nearly all the electrical energy is converted into heat in the metal to be melted. The ring being of constant cross section, the heating is about uniform over the whole bath of metal. The Rochling-Rodenhauser furnace has a differently shaped hearth to the Kjellin furnace and a description would not be out of place at this juncture. The furnaces are constructed either for single or three-phase current. In the former case there are two grooves and in the latter, three grooves. In both cases these grooves, which are similar to the grooves in the Kjellin furnace, open into a distinct open hearth. The cross section of the grooves is comparatively small and they form the secondary circuits in which the currents which heat the metal are induced. Lateral doors are provided so that the contents of the working chamber may be watched, slag drawn off or charge put in. The chief electrical difference between the Rochling-Rodenhauser and Kjellin furnace is that a distinct secondary winding is provided in the former and the current induced is led by means of heavy terminals to plates embedded in the refractory material of the furnace. This refractory material becomes an electrical conductor at the higher temperatures, and this enables an additional circuit to be formed, so that the currents induced in the secondary winding pass through the bath of metal, heating the bath still further. The current also serves to neutralize the great self-induction of the secondary and a better power factor is obtained. The point to be recognized here is that the heating is uniform and not localized as in the Heroult furnace.

Variation of Load on Supply Mains.

Arc Furnace. The instability of an arc is well known and the load on a supply circuit, even with constant watching, varies very greatly. If the furnace has its own generator the regulation can be effected more simply, but the best furnace is one which can be connected to regular three-phase supply mains. To do so with the Heroult furnace means motor-driven electrode regulators, etc., and even then the furnace is not a very desirable load.

Induction Furnaces. The changes in load on an induction furnace are always of the intentional kind and sudden changes of load are practically impossible with an induction furnace.

Adaptability to Connection to Supply Mains.

In the question of power factor the Heroult furnace shows some advantage over the Kjellin furnace for in order to build a Kjellin furnace of eight-ton capacity and keep the power factor up to 0.6 or 0.7 it was necessary to lower the frequency to five periods per second. As a five-cycle generator costs more than twice as much as a 25-cycle generator this is a serious question. But with the Rochling-Rodenhauser furnace the current in the second secondary winding can be used to neutralize the effect of self induction to such an extent that a seven-ton furnace may be operated with 25 cycles with a power factor of 0.6 while a three-ton furnace on 25 cycles has a power factor of 0.8. The smaller Rochling-Rodenhauser furnaces are operated from 50 cycles with power factors of 0.85 and 0.8. In my opinion the most economical way to correct this evil is by using fixed condensers which cost only a small percentage of the cost of the furnace and the power factor may be made as high as desired.

Electrical Efficiency.

Arc Furnaces. The before mentioned Girod furnace with but one electrode of 14 in. (35.5 cm.) diameter and a current of 6200 amperes at 60 volts showed a power loss of 10 per cent in the electrode alone. In the Heroult furnace the current is in general smaller but there are two electrodes in series and the result is about the same. Not only is energy lost in the electrodes by reason of their high resistance but a large amount is also lost by means of the water cooling of the jackets which is necessary because of their high conductivity for heat. The cost of maintenance of carbon electrodes is also considerable. Radiation loss is greater with the arc furnaces because a great deal of the heat of the arc is reflected to the roof which must be water cooled to last, and even then has to be renewed about every 14 days.

Induction Furnaces. Tests made on a 3.5 ton furnace at Volklingen have shown an electrical efficiency of 97 per cent which is a contrast to the 10 per cent lost in electrodes alone in arc furnaces. The electrode plates never wear out for they do not come in contact with the molten metal or slag and the portion of the lining which acts as a conductor has been found in practice to last longer than any other portion of the lining.

Summary of Electrical Features.

a. Heating of metal bath is much more uniform in induction furnace.

b. The variation of load is much less with the induction furnace.

c. The adaptability to connectiôn to existing power networks is in favor of the induction furnace.

d. The efficiency is in favor of the induction furnace.

Metallurgical Features.

The earlier induction furnaces, i.e., those of the Kjellin type did not show many metallurgical advantages except that it was possible to treat much larger charges than with crucible methods. They were quite unsuited to working with slag because of the shape of the hearth and so only served to melt pure materials. The shape of the Rochling-Rodenhauser furnace is such that slags can readily be handled and refining carried on. At the same time it can be used for smelting work whenever necessary, and as much larger charges can be worked, a considerable saving is made in crucible steel working.

The advantages of the electric furnace are:

1. On account of the convenient regulation of the temperature attainable the phosphorus can be removed until only a trace remains.

2. It is especially suitable for the most thorough desulphurization.

3. When the refining is complete, the charge can be left in the furnace as long as may be desired without change of composition.

At Trollhattan, Sweden, the furnace is started by means of a ring of metal. The cold materials are charged gradually until all are melted. Continuous

operation is possible by leaving a portion of the molten metal in the furnace after each teeming.

At Volklingen, Germany, the furnaces are supplied with molten metal from basic Bessemer converters which contains about 0.08 per cent S and 0.08 per cent P. The extent of the dephosphorization and desulphurization depends on what the steel is wanted for.

The oxidizing slag is formed from lime and mill-scale or ore, which is removed as far as possible when dephosphorization is complete. The recarbonization takes place and a slag free from iron is formed for desulphurization. A typical slag for desulphurization has a well-known white appearance and falls to a white powder on exposure to the air. When the slag has this property, the charge may be left as long as desired in the furnace. The furnaces are entirely emptied after each charge as the molten converter steel allows the load to be readily brought to a satisfactory figure.

When not working, about one-third of the normal energy will keep the furnace hot. The seven-ton furnace at Volklingen has been 30 hours without taking any current and was heated up again with normal energy consumption. Within half an hour the metal began to glow and regained its normal temperature after four hours and the charge was finished up in the regular way. At the works at Volklingen no work is done on Sunday but there is no difficulty in starting up the furnaces with unfinished charges from the previous Saturday.

The natural circulation which takes place in induction furnaces serves to thoroughly mix the charge and the management of the Poldihutte, Austria, made a test in which seven samples were taken from six different places in the furnace and the analysis of these samples is shown in the following table:

	Carbon Per ct.	Manganese Per ct.	Silicon Per ct.	Phosphorus Per ct.	Sulphur Per ct.	Chromium Per ct.
1	0.81	0.27	0.335	0.031	0.007	1.00 1.01
2	0.77	0.25	0.340	0.030	0.008	1.00 1.01
3	0.85	0.28	0.345	0.029	0.007	1.00 1.01
4	0.82	0.27	0.335	0.039	0.009	0.98 0.99
5	0.78	0.25	0.335	0.030	0.009	0.99 0.96
6	0.78	0.27	0.419	0.031	0.010	0.99
7	0.79	0.28	0.326	0.030	0.009	0.98

The furnace was teemed 37 minutes later and a sample cast out of the ladle gave the following analysis:

Carbon	0.77 per cent.
Manganese	0.29 "
Silicon	0.396 "
Phosphorus	0.031 "
Sulphur	0.009 "
Chromium	0.99 "

That the Rochling-Rodenhauser furnace is no longer an experiment is shown by the fact that the 3.5 ton furnace was worked for a whole year producing steel for rails, and more than 5000 tons have been sold. The eight-ton furnace has been running since November, 1908, an average of 14 days to a lining and 1200 tons of rails to a lining. The management contemplates the building of a 16-ton furnace as the next step.

At Dommeldingen the two-ton furnace is used to refine crude pig iron.

	Analysis of charge.	Analysis of cast.
Carbon	4.0 per cent	0.5 per cent
Phosphorus	1.8 "	0.025 "
Sulphur	0.2 "	0.03 "
Manganese	0.0 "	0.76 "
Silicon	1.05 "	0.056 "

Breaking strain	95,000 lb. per sq. in.
Elongation	20 per cent
Contraction of area	36.33 "
Duration of conversion	5 hours

Summary of Metallurgical Features.

1. Having no electrodes, facilities are provided for heating the bath without introducing impurities and the charge may be left indefinitely in the Rochling-Rodenhauser furnace without change.

2. Having a large open hearth, (in the 1.5-ton furnace it is 60 by 26 in. or 1.52 by 0.65 m.) with doors it is possible to do any class of refining in the Rochling-Rodenhauser furnace much the same as in the open hearth furnace.

3. When the hearth doors are closed the Rochling-Rodenhauser furnace is air-tight and may be left for long periods without great loss of heat, making intermittent working possible.

4. The natural gentle movement of the charge allows of complete mixing of the ingredients of the charge, and is not sufficient to attack the lining.

Costs.

Royalty. The German users of the induction furnace pay $0.65 per ton for rail steel and $1.50 per ton for crucible quality steel. This is for small daily production. For 1000 tons daily the royalty is placed at $0.36 per ton for rail steel and for 1200 tons daily it is $0.50 for crucible quality steel.

Energy Required. A great many figures have been given out most of which were for small furnaces and special runs. The plants at Trollhattan and Volklingen being in commercial operation supply the most reliable figures obtainable.

Cold Pig and Scrap. With cold materials, refining, etc., to crucible quality steel is done with 600 to 900 kw.-hr. per ton according to the size of the furnace.

Hot Pig and Scrap. With hot pig iron and cold scrap crucible quality steel is obtained with 300 to 700 kw.-hr. per ton according to the proportions of the two ingredients and the size of the furnace.

Hot Metal from the Converter. Converter material with an analysis of P, 0.08 per cent; S, 0.08 per cent; Mn, 0.5 per cent; C, 0.1 per cent is refined to steel for rails with an analysis of P, 0.05 per cent; S, 0.04 per cent; Mn, 0.85 per cent; C, 0.5 per cent with 100 kw.-hr. per ton in a seven ton furnace. Same material is refined to high quality steel showing only traces of P and S; Mn, 0.2 per cent; C 0.5 per cent with 250 kw.-hr. per ton.

Hot Metal from Open Hearth Furnace. Material from open hearth furnace, already dephosphorized and desulphurized and containing 1.22 per cent C; Mn, 0.38 per cent; Si, 0.21 per cent to high quality steel with 200 to 250 kw.-hr. per ton.

Cost of Production. (1) For a 1.5-ton furnace melting scrap and refining to pour best steel for steel castings. Furnace of the three-phase, tilting type, 50 cycles, 210 kw. and power factor 0.80.

Interest Charges. Cost with all accessories about $9000. With 10 per cent for interest charges gives $900 annually. Using 290 working days in a year and six charges, 3 to 3.5 hours each, daily and 1500 lb. to a charge gives 4.2 tons daily and 1220 tons yearly. This is equivalent to about 21 hours working. Cost per ton for interest, $0.74.

Labor. Two men can attend to this furnace with ease, as the electrical part requires no special attention. The melter adjusts the temperature and watches the metallurgical process. The helper sees to the fan and charging, etc. Allowing two shifts and $5.50 per shift or $11 daily gives a labor cost of $2.62 per ton of steel.

Lining. Relining may be done every 8 or 14 days. It takes three tons of magnesite and 0.36 ton of tar to completely reline the furnace. The relining is done with half new material and half old. For getting out the old lining, mixing material and putting in the new, four men are allowed 16 hours. Cost of lining per ton of steel, on an average, $1.50.

If lined with dolomite, which is cheaper, and every 14 days then lining cost allowing one-third material recovered is 31.00 per ton of steel.

Keeping Warm. When the furnace is not used for several hours during the night, it must be kept warm, for which about a third of the working amount of energy is necessary. In this way if normal energy is 200 kw. then about 200 kw.-hr. will be necessary to keep the furnace warm over the three-hour period of rest. For six working days this is necessary five times and 1000 kw.-hr. must be charged up to heating.

Cost of keeping furnace warm at $20.00 per kw.-yr. is $0.09 per ton of steel.

Cooling of Transformer. The blower takes a 2.5-h.p. motor or 1.8 kw. and for 24 hours = 43 kw.-hr.

Cost of cooling transformer per ton of steel, $0.02.

Energy Consumption. From cold materials about 850 to 900 kw.-hr. are necessary, in this size furnace. Taking larger figure the cost of energy per ton is $2.06.

Royalty. In the United States, on the basis of a plant of 50 tons daily the royalty would be about 50 cents per ton.

SUMMARY OF COST.

Interest charges	$0.74
Labor	2.62
Lining	1.50
Keeping furnace warm and cooling	0.11
Royalty (approx.)	0.50
Energy for melting and refining	2.06
Total	$7.53

The figure $7.53 is the working cost which must be added to the cost of the materials in order to find the cost of crucible quality steel from scrap. The above figure would be more reasonable with larger furnaces.

Cost of Production. (2) For a two-ton, 300 kw., three-phase tilting furnace.—Molten converter steel to quality steel for castings.

Cost with all accessories about $12,500. With 10 per cent for interest charges gives $1250 per annum. Allowing 250 working days in the year and 16 tons per day gives 4000 tons per annum or $0.31 per ton of steel.

Interest charges per ton of steel	$0.31
Power for heating up, per ton of steel	0.02
Power for refining, allowing upper figure of 300 kw.-hr. at $20 per kw.-yr.	0.68
Air cooling of furnace core	0.01
Cost of lining every ten days. (German figure)	0.35
Wages allowing $16 per day	1.00
Royalty on basis of 50 tons daily	0.50
Total cost per ton of steel	$2.87

This figure would give a good idea of the cost of converting molten pig iron into steel, exclusive of the ferro alloys.

Cost of Production. (3) For a five-ton, 550 kw., three-phase tilting furnace.—Molten converter steel to crucible quality steel.

Cost with all accessories about $22,000. With 10 per cent for interest charges gives $2200 per annum. Reckoning 250 working days in the year, each one with eight heats of five tons, the yearly production would be 10,000 tons, or $0.22 per ton for interest charges.

Interest charges	$0.22
Power including heating up. For a monthly average of 230 to 280 kw.-hr. per ton and taking the higher figure	0.64
Cost of lining. (German figure)	0.30
Wages allowing $20 per day	0.50
Air cooling of core	0.01
Royalty (Approx.) Basis of 50 tons daily	0.50
Total	$2.17

Cost of Production. (4) For a seven-ton, 750 kw., three-phase, 25-cycle, 0.6-power factor tilting type furnace.—Converting molten converter steel into high grade rails.

Cost with all accessories $27,000. Interest charges at 10 per cent gives $2700 per annum. Allowing 100 tons daily (the makers claim a production of 140 tons) and 250 working days in the year gives a yearly production of 25,000 tons of rail steel and interest charges per ton of steel = $0.11.

Interest charges	$0.11
Power for heating up	0.01
Power for refining. Makers claim 100 kw.-hr. per ton. Allowing 150 kw.-hr. per ton	0.34
Power for cooling	0.01
Cost of lining. Pneumatically tamped. Two foremen and six laborers, or $21.00 daily. Per ton	0.02
Cost of lining material. (German figure)	0.06
Wages. Two head melters at $3.00 and 10 helpers at $2.50, $31.00 per ton	0.31
Royalty on rail steel, one furnace in U. S.	0.35
Total	$1.21

This is the conversion cost which added to the value of the pig and ferro alloys, etc., gives the cost of steel for rails. The Prussian Railways paid $10 extra per ton for rails made in this furnace and were well pleased with the product.

Cost of Production. (5) For a seven-ton, 750-kw., three-phase, 25-cycle, 0.6-power factor, tilting type furnace.—Molten converter steel to highest quality steel.

This furnace will produce about half the steel of this quality as when working on rail steel or 50 tons daily.

The cost per ton under these conditions is about $2.00 per ton including royalty.

SUMMARY OF COSTS OF PRODUCTION EXCLUSIVE OF MATERIALS.

1 5-ton furnace melting scrap and refining to pour high grade steel for castings. Per ton	$7.53
2-ton furnace refining molten converter steel to high grade steel. Per ton	2.87
5-ton furnace refining molten converter steel to high grade steel. Per ton	2.17
7-ton furnace refining molten converter steel to high grade steel. Per ton	2.00
7-ton furnace refining molten converter steel to high grade rails. Per ton	1.21

ELECTRICAL PRECIPITATION OF SMELTER FUME.[1]

BY E. G. COTTRELL.

The attempt to utilize electric current for the precipitation of suspended matter, particularly with regard to smoke and fumes, dates back a great deal further than we perhaps realize. The first suggestion of its use that I have been able to find was in 1824, when Hohlfeld, in Kastner's Archiv. Naturl, suggested that by the use of static electricity smoke might be precipitated. It seems then to have dropped out of sight for a quarter of a century, and to have been re-discovered and re-proposed by Guitard in 1850, in the Mechanics' Magazine. Here again it was simply thrown forward as a suggestion; it came to no practical application, and lay dormant again until discovered independently for a third time by Sir Oliver Lodge in 1884.

Lodge came on it rather indirectly. He was working on the effect of depositing solids on cold bodies. If you take a cold rod of metal, and place it in a mass of smoke, and then look along the rod, you can see a thin clear space free from the smoke, surrounding the rod. The explanation that Lodge offered, and which has been substantiated by others, is that we have a molecular bombardment of particles; that is, the cold rod, reducing the velocity of the gas molecules around it, gives a chance to the more heated spaces outside to allow their molecules to bombard these particles at a higher rate than the cold gas molecules in contact with the rod. In studying this phenomenon and the general sedimentation of dust, he was led to try the effect of the electrification of the rods as an incident of the work, and was surprised to find that the smoke and various fumes cleared up. He followed it out in rather more extensive detail, and presented his results in a lecture before the Manchester Section of the Society of Chemical Industry, which was later published in the journal of the society.

This seems to have been the first incentive to a general study of the problem. It did not take long for the practical men to see the possibilities in the work, and in the next few years it was taken up actively, and the first patent was drawn on the precipitation of smoke by electrical means. This initial patent, which claimed the application of electrical charges to the precipitation of suspended matter in general, was taken by Alfred Walker, of the firm of Parker & Walker, lead smelters, in Lancashire, and was carried out not only on paper, as many patents are, but was embodied in an actual installation. The Wimshurst machine had just come out at that time, and great things were expected of it. It is rather amusing today with our present knowledge to read the predictions made at the time that the Wimshurst, being so perfectly adapted to commercial operation, was undoubtedly the solution of the problem. Two large machines, with plates about five feet in diameter, were constructed for this purpose. The installation evidently did not prove a success as no further account of it is to be found.

There are two problems which stand out quite distinctly, one, the treatment of commercial gases, passing through flues, in which they must be handled promptly before discharge into the atmosphere; and the other to which Professor Lodge has more particularly given his attention—the treatment of fog and smoke in the open, particularly fog, where you have a tremendously extended mass but relatively quiescent. You notice that fogs are usually in quiet air, and the idea of simply agglomerating the suspended particles into larger masses and then allowing them to settle is more readily applicable to fog treatment than it is to the treatment of industrial flue gases. The work that I will show you this evening has been almost entirely confined to the second problem, that is, the treatment of industrial gases, so what I have to say must be taken in that sense, and not as relating so particularly to the treatment of fog in the open. In the latter case some very interesting work seems to have been done in Europe upon the effect of powerful electromagnetic waves in causing agglomeration in foggy air, but very little seems to have been published as yet, probably on account of its commercial possibilities. It depends more particularly upon sending the train of Hertzian waves out into the air, and in that way producing an agglomeration of the fog particles which then fall as rain. This seems rather a promising direction for that line of work.

That same treatment does not apply practically, as far as we have been able to determine, to the treatment of industrial gases, because of the high velocity here encountered. You usually have to treat a very large volume of gas in a relatively small space, both of time and in the sense of area. The capacity of the flues is naturally limited, and you cannot afford to hold the gases long, and you must treat them rapidly as they move.

(The speaker then exhibited a number of stereopticon views, showing various installations erected under his direction for the treatment of rapidly moving gases in large flues of smelters and similar establishments, and showing the effect of the apparatus used, after which the process was demonstrated by experiments).

[1]Stenographic report of talk before San Francisco Section A. I. E. E., March 24, 1911.

The synthetic ammonia process has passed from the discoverers to the Badische Anilin and Soda-Fabrik, of Germany, which informs the Berlin consulate general that the process is only in the experimental stage and that there is no immediate prospect of synthetic ammonia being placed upon the market. According to a local technical journal, the chemical inertia of nitrogen toward hydrogen, which has heretofore been an insurmountable obstacle to the synthetic production of ammonia, was overcome in the case of the Haber process by high pressure applied in the presence of catalytics. A mixture of the cheapest nitrogen and hydrogen gases in the proportion of 1 to 3, with uranium powder containing carbon added as a catalytic, was converted into ammonia gas (NH_3) under a pressure of 200 atmospheres and at a temperature of 500 degrees C. Only about 8 per cent of the gas mixture was converted, but by removing the ammonia gas, either by liquefaction or by means of a chemical absorbent, the transforming process may be made continuous.

IMPROVEMENTS IN EFFICIENCY OF ELECTRIC LIGHTING PROPERTIES AND WHAT THE PUBLIC GAINS THEREBY.[1]

Gain to the public through improvements in the efficiency of electric lighting properties was discussed and demonstrated by W. H. Blood, Jr., Tech. '84-'88, of the Stone & Webster Engineering Corporation, Boston. At the present time, said Mr. Blood, when so much is being said about "efficiency" and "scientific management," and when the public service corporation is accused of being "greedy" and "unscrupulous," it may be well to spend a few moments in considering what the application of science to the electric lighting industry has accomplished and to what extent the public has been benefitted thereby.

In 1888, two of us, for our thesis work, tested the largest dynamo that the Institute of Technology possessed, and found the highest ratio of electrical output to mechanical input to be about 70 per cent. Today, machines of this size operate at about 85 per cent, while larger units give efficiencies of 95 or even as high as 97 per cent. Assuming that this improvement in efficiency amounts to 25 per cent, on the average (which is a low estimate), it would mean that we are today saving 25 per cent of the fuel which we should have burned had there been no improvement in electrical efficiency since the year 1888.

Applying this figure to the industry as a whole and basing our estimate upon figures given in the Census Reports on the cost of fuel used by the electric light and electric railway plants in the United States we prove, without fear of contradiction, that our electrical engineers have brought about the conservation, for future generations, of some $12,000,000 worth of coal per year, and this solely on account of a single item—improvement in the efficiency of electric generating machines.

We find, on looking up the back records, that in the early days it took, as a rule, ten or more pounds of coal to produce one kilowatt hour. In many modern stations it requires only three pounds of coal per kilowatt hour, and in some cases even, less than this. This means that only 30 per cent as much coal as was demanded twenty years ago is now needed to produce a unit of electricity.

What effect does this have on the cost of electricity? Take for a concrete example an electric light plant of 5,000 kw. capacity. Its first cost, including distributing lines, would be approximately $1,250,000, and under ordinary conditions it would have an earning power of about $312,000. The operating expenses, including taxes and depreciation, would be, say 65 per cent, of this, or $202,800, which would leave for interest on investment and reserves $109,200.

Now suppose that instead of having a power station which runs on three pounds of coal per kilowatt hour, it was like those in operation in 1888, and consumed ten pounds of coal per kilowatt hour. With the same output over 300 per cent more coal would be required: or, instead of producing a return of 8¾ per cent on the investment (which we assume is the same in both cases) there would be a deficit of about 5 per cent, or, if you please, stating the results in another way, while the company has been making systematic reductions in the rates from 15 cents per kilowatt hour down to 10 cents per kilowatt hour, its stockholders here had to be content with a constant and low rate of return upon their investments. If you will study the records of the electric lighting companies given in the reports of the Massachusetts Gas and Electric Light Commissioners, you will find that this is exactly what has taken place in this State at least.

But we have not told the whole story yet. The development of alternating current apparatus has enabled the electric lighting companies to distribute their product from the power station to the consumers at a much less cost and has made it possible to transmit it for distances which were not dreamed of in the early days.

High voltage transmission has further enabled us to utilize that were heretofore useless and almost inaccessible waterfalls. Without this development, Los Angeles would be forced to burn thousands of barrels of oil each day instead of using the mountain streams two hundred miles away for making her streets at night almost as brilliant as in the day. But for this development Seattle would not be able to utilize the melting snow and ice from the glaciers of Mt. Rainier to operate all her street cars and other public utilities. Without high tension alternating current apparatus, Niagara power could not be transmitted and used in the Lake cities of Canada, or in Buffalo, Syracuse or Rochester. The utilization of Niagara power alone means a yearly saving of at least 2,500,000 tons of coal, or the conservation of $6,000,000 to $7,000,000 of fuel annually. The development of the high tension alternating current system has therefore not only been the means of reducing the cost of distributing electric power and of preventing the congestion of manufactories, but has also been a great factor in conserving our natural resources.

Turn now to the apparatus by which the consumer transforms the electricity delivered to him into light, heat and power. Here again scientific study and research have done much to increase the efficiency of the apparatus used. The reduced price of electricity by itself, therefore, does not indicate the total saving of the consumer. We have today our lamps of more than 100 per cent greater efficiency than those of a few years ago.

The wonderful advance which has taken place in the last twenty years in the electric lighting industry has been due to the combined efforts of the operating engineer and the designing engineer. It has been a gradual and steady evolution and is still going on. The industry itself has not reaped all the benefits, for while the returns on electric light investments have been sure they have not been as large as the dividends which the public has received in the reduced cost of electric light and power.

[1] From a paper presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

CHINESE TELEPHONE AND TELEGRAPH SYSTEMS.

On January 1, 1909, there were in Tientsin 1304 telephone connections, of which 53 were extension or private lines, 4046 miles of cable wire, and 1853 miles of open wire. After that date the telephone administration adopted the Chinese calendar, and the following official returns are furnished: End of 12th moon, 1st year of Hsuan Tung (February 13, 1910), 1518 subscribers, of which 70 were extension or private lines, 4468 miles of cable wire, and 2016 miles of open wire. End of 10th moon, 2d year of Hsuan Tung (December 1, 1910), 1777 subscribers, of which 127 were extension or private lines. The wire mileage is not made up until the end of the Chinese year.

The engineer in charge of the Peking Telephone Administration furnishes the following figures:

Year.	Subscribers connected to office.	Subscribers waiting for connection.	Mileage of wires.
1908	1,563	784	5,198
1909	1,608	970	5,353
1910	1,623	1,251	12,819

The engineer further says: "From 1907 we stopped connecting subscribers, as our switchboard capacity was not sufficient, unless we should entirely change the switching system. In the summer of 1910 we commenced extension of the telephone work, installing common battery multiple switchboards and laying underground cables. This work is still going on."

The new telephone installation, now in progress in Peking, will cover both the Tartar and the Chinese city. The work is being done directly by the Imperial Chinese Telephone Administration, with the assistance of two specialists sent out for this work by the Western Electric Co., of New York and London, which furnishes the machinery and apparatus. It is expected that the installation will be completed and ready for use by May, 1911. The system is known as the common battery (magneto) system, which has been in operation in the United States for more than 12 years.

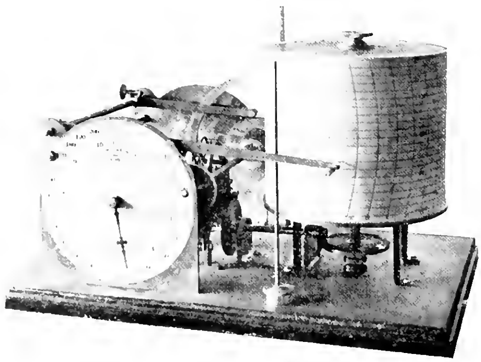
Two telephone exchange buildings have been erected. The first is a large foreign edifice, of red brick, on the Hatamen Road, and the second is in the Chinese city, close to the Tartar city wall. Three thousand telephones are being put up, but the plant will admit of an increase to 12,000, as the switchboards at each of the two exchanges have a capacity of 6000 telephones. The telephone wires have been laid underground. This, although it has increased the initial outlay, will greatly reduce the subsequent cost of maintenance, as no damages to poles or wires, caused by gales, etc., will have to be reckoned with.

The cables are of lead tubing $3\frac{1}{2}$ in. in diameter, and contain 400 wires. The wires are wrapped loosely in paper, the function of the paper being merely to hold the wires apart. The cables are laid in earthenware pipes.

All the foreign subscribers' numbers will be assembled on one section of the switchboard, which will be in charge of operators who understand English. This will save a great deal of time and worry.

NEW INDICATING AND RECORDING WEIR GAUGE.

A valuable device, recently designed and constructed by R. G. Manifold and C. O. Poole of Los Angeles, Cal., is illustrated herewith. This apparatus is constructed with a float operating a vertical rack meshing into a gear of proper diameter, and operating a cross shaft carrying a spiral cam, from which the motion of the recording pencil is derived; this cam, which is almost a logarithmetic spiral, is designed to give a motion to the pencil proportional to the flow in second feet of water over the weir, and not simply



the height as in other gauges; the recording drum is revolved by a special double spring clock, of strong design, and can be geared to register daily or weekly readings; in addition to the recording drum apparatus there is a fixed dial, on which is read the height of the water and the corresponding flow at any time.

After putting a new card on the drum the thumb nut on top is loosened and hour line set exactly, there is also a tangent screw for raising or depressing the pencil to correspond with indicated flow.

The principal advantage of this style of gauge is, that the card taken from the machine may be computed by getting the area with a planimeter and applying a suitable constant.

A condensing gas stove recently perfected in England provides that the fumes from the burnt gas rise into a flat, oblong tank, about 3 feet long, which forms the top of the stove. Thence they are conducted by four tubes, also about 3 feet long, down to a similar tank, which constitutes the base. This tank contains water and slaked lime, and the fumes, cooled by their circulation through the apparatus and by contact with the water, pass round to meet the hot fumes in the flue behind the burners. The result is rapid condensation, with production of a vacuum, which causes the draft necessary to draw air into the fire. The water of condensation absorbs the carbonic acid, and, trickling down into the bottom tank, combines with the lime, forming carbonate of lime, which, being insoluble, is precipitated. As the slaked lime is used up, the carbonic acid combines with the carbonate of lime to form bicarbonate, which is soluble, and the solution, when its amount becomes excessive through the constant additions of condensed water, is drawn off by a small tap

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Pacific Coast Electrical Convention

The past week has witnessed two national conventions of electrical men on the Pacific Coast. A representative body of the business interests assembled at the Del Monte meeting of the National Electrical Jobbers' Association, while the technical men met at the Los Angeles session of the American Institute of Electrical Engineers. Aside from the value of the papers presented, both conventions were distinguished by a lavish entertainment characteristic of Western hospitality.

Their success should be an added incentive to like meetings of other national organizations in the future, especially that of the National Electric Light Association for which Portland is the claimant. It is no more than logical, also, that Seattle be the scene of the next Pacific Coast meeting of the American Institute of Electrical Engineers, which custom was inaugurated last year at San Francisco.

Lessons for the Designer

A remarkable similarity in operating methods of widely-separated power plants is exhibited in R. J. C. Wood's abstract treatise, as published in this issue, and Magnus T. Crawford's concrete record of the Snoqualmie Falls operation, as presented at the Los Angeles Institute meeting. They should be of value not only to operators, but particularly to designers who are too prone to neglect these factors. Faultily-designed apparatus handicaps the efficiency of an entire system and can be avoided only by careful study of the conditions under which the plant must run.

Power plant operators have an unwritten law to withhold all information regarding accidents, interruptions and many other occurrences which would be of interest to engineers and of value to the art in general. It is questionable whether such reticence accomplishes its intended purpose, for insinuating rumors usually do more harm than a frank statement of facts upon which to base intelligent action to obviate repetition of like disaster.

As a motto for the operating engineer and as a criterion for the power system, Mr. Wood recommends "capability, reliability, flexibility and repairability," epigrammatic though not etymologic differentials of ability. According to the dictionary, "ability includes every form of power, capability being but the power to receive and efficiency but the power to do." Ability is thus seen to be all inclusive, the integral of the equation of success, and as such we commend it to the designer, who should be able to do as well as plan operating methods.

Irrigation Engineering

Noteworthy among the papers at the Los Angeles session having a bearing on engineering practice in the West was that by O. H. Ensign and James M. Gaylord, describing the application of electricity to the United States irrigation projects in the Salt River basin in Arizona and the Minidoka district in Idaho. In the arid areas of the West the development of every industry except mining has depended largely upon irrigation. The area of the gravity-

irrigated sections, naturally the first to be developed during the past fifty years, is absurdly small in comparison with the total which needs but the magic touch of water to become productive. Recently thousands of acres have been irrigated by gasoline pumping from wells, but this use has necessarily been limited.

Since the commercial use of transmitted electric power, several large hydroelectric companies have systematically encouraged electric pumping by means of a campaign of education as to its advantages to the irrigator. The disadvantages of a low load factor, small units, extensive distributing lines and delayed returns on a large investment are compensated by the ultimate business whose eventual success is as inevitable as is the final peopling of a highly productive but virgin country. But there are many projects of such magnitude as to make their financing impossible for a private company. Several of these have been developed by the government after careful investigation to establish standards of construction and cost. The government is not competing with companies already in the field, but has left the more promising localities to private development. Its influence has been potent in educating the people to see the possibilities of power irrigation and to materially assist further development on a smaller scale in other sections.

Electric Iron Smelting

From time immemorial coal and iron have been as intimately associated as bread and butter, or ham and eggs. The smelting of iron ore requires an intense heat in a reducing atmosphere and some means of supporting and separating the ore particles. Oil fulfills the first of these requirements, but fails in the last. Coal or coke supplies them all in cheap form, whereas charcoal is expensive. As a result, many iron deposits have not been developed simply because coal was not available for their treatment. Recent economies in the generation of electricity, particularly in coalless localities, make it a cheap heating agent for smelting iron, copper and zinc, charcoal or other carbonaceous material performing the combined function of separator and reducer.

For this purpose three types of furnaces have been developed—the arc, the induction and the resistance—with decreasing temperature capabilities in the order named. As the arc furnace has been the most extensively tried in this connection its limitations have been the first found, the most serious being the excessive cost of carbon electrodes and the uneven heat distribution.

These faults and the corresponding advantages of the induction furnace are detailed in C. F. Elwell's paper in this issue with particular reference to steel-making. Though Mr. Elwell has had some little practical experience with the arc furnace and an excellent opportunity to investigate the various European types, his treatment seems somewhat biased in favor of the induction design. Unfortunately, few local engineers possessed sufficient information to meet his arguments at the Los Angeles meeting of the Institute, those so equipped being hampered by commercial restrictions. After much experimenting with the Heroult arc furnace at its plant in Shasta County, California, the Noble Electric Steel Company is now investigating the induction types. Both methods have been successfully developed in Europe, where it has been found that circumstances alter cases, each being best suited for certain conditions.

With power at one-quarter cent, or less, per kilowatt hour, the electric furnace is destined to become a formidable rival of the crucible method of producing high-grade steel, because it is cheaper. Its product is equally good, and far superior to the open-hearth process. In iron-making its greatest field lies in the treatment of low-grade ores whose sulphur and phosphorus cannot be satisfactorily eliminated in the older processes. Thus in time electricity and iron will become as closely coupled in making iron as they now are in generating electricity.

Power Diagram Indicator

Of the more theoretical papers, that in which Professor Harris J. Ryan describes his power diagram indicator stands foremost. This one instrument makes measurements heretofore possible only with complicated switchboard equipment and delicate laboratory apparatus. Its "card" bears much the same relation to the study of conditions in an electric circuit as does that from an engine indicator to those in a steam cylinder.

An X-ray, magnetically focused on a fluorescent screen, is passed through the electrostatic field between four concentric poles, or "quadrants," connected respectively to the voltage and current components of the power in the circuit being studied. The ray is thereby deflected, and in rotating traces a closed diagram whose area is proportional to the energy vertical displacement to the pressure, horizontal movement to the current, and whose inclination shows the power factor. By the use of a revolving mirror the wave-form may also be seen. Furthermore, in the case of a non-conductor the instrument shows the hysteresis loss.

In its present form it is merely a laboratory instrument, which in the words of its creator "has been found satisfactory for the study of high-tension insulation and insulators, dielectric losses in high-tension transformers, insulating qualities of transformer oils as affected by moisture, impurities, etc., losses in the atmosphere from high-tension lines," and similar phenomena. It seems possible of development into the more compact and convenient form necessary for the practical man.

The Conserving Engineer

As a conserver, the engineer has been far more effective than the legislator. The one utilizes natural resources, the other hoards them; one is a humanitarian whose efforts are compounded, the other a miser or a dog in the manger. This is especially true of our unlimited and indestructible water powers which are being bottled up, while other irreplaceable products are being wastefully destroyed for purposes to which hydraulic energy is better adapted.

PERSONALS.

C. L. Cory made a business trip to Los Angeles during the past week.

C. J. York, the head of the Downieville Light & Power Company, arrived at San Francisco last Tuesday.

H. H. Hoxie, manager of the Woodland Electric Works of Woodland, arrived at San Francisco last Tuesday.

Sidney Sprout and A. C. Sprout have returned to San Francisco after a Northern California tour on engineering business.

Melville Lacey, manager of the Hanford Light & Power Company, arrived at San Francisco last Wednesday from Hanford.

Alexander Rosborough, one of the owners of the Siskiyou Light & Power Company's system, was a recent San Francisco visitor.

F. G. Baum, of F. G. Baum & Co., returned last week to his San Francisco office from an important business trip to New York City.

A. W. Smith, secretary of the Sacramento Valley Power Company, with headquarters at Redding, spent last Saturday at San Francisco.

Wynn Meredith, Pacific Coast manager of Sanderson & Porter, left last Wednesday for a three weeks' visit to the firm's New York office.

A. E. Ransom, of the Seattle office of the Westinghouse Electric & Manufacturing Company, has returned to Seattle from a short trip to California.

E. P. Colinan, the electrical engineer of the Tonopah-Belmont Mining Company, arrived at San Francisco from Tonopah during the past week.

Leon M. Hall, of Hall, Demarest & Co., engineers, spent a few days last week at Virginia City, Nev., among his old acquaintances of the Comstock Lode.

W. S. Heger, California manager for the Allis-Chalmers Company, returned to San Francisco during the past week after a visit to his Los Angeles office.

H. C. Stoddard, who is connected with the Rogue River Electric Company of Medford, Ore., left San Francisco last Tuesday and returned to the company's plant.

Darcy A. Lyon, who constructed the original electric furnaces for the Noble Electric Steel Company, at Heroult, Cal., is studying electric iron smelting methods in Europe.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company of Chicago, returned to San Francisco last Saturday after a tour of Oregon and Washington.

Charles C. Moore, of Charles C. Moore & Co., who was recently elected president of the Panama-Pacific International Exposition Company, has returned to San Francisco from New York.

T. F. Jack, head of the detail and supply department of the Seattle office of the Westinghouse Electric & Manufacturing Company, died April 15 from pneumonia complications. Though but 32 years of age, Mr. Jack had already earned a high position and gave promise of a most successful career, thus prematurely ended.

W. P. Hammon, head of the California-Nevada Power Company, the Mojave Power Company and other important hydroelectric corporations, has returned to California after a short trip to New York. The report is current that the business that he was occupied with had to do with the formation of a large oil syndicate in which English and American capital had become interested, with the purpose of securing wells in the Coalinga district.

W. F. Kelly, who has been for the past eight years general manager of the Key Route system and for thirteen years at the head of the Oakland Traction Consolidated, has voluntarily sent in his resignation, effective May 1. His successor has not yet been announced, but it is more than probable that J. Q. Brown, the chief engineer of the entire system, will be appointed to fill the vacancy. He has had years of experience with these lines, and is familiar with all of the details of operation and maintenance.

NATIONAL ELECTRICAL JOBBERS' CONVENTION.

The first Pacific Coast Convention of the National Electrical Supply Jobbers' Association is in session at Del Monte, California, while this issue is on the press, so that a detailed account cannot be given until next week.

The San Francisco delegation, sixty strong, were the first to arrive on the scene, the Eastern and Southern representatives getting in late Monday night after a hilarious and joyful transcontinental trip. Late arrivals are still straggling along but the indications are sure for nearly three hundred, including the ladies.

The meeting, though ostensibly for the purpose of discussing business matters, has developed into a huge junketing expedition, with every facility of California's finest at the disposal of the participants. The jobbers are so greatly outnumbered by the ladies and the manufacturers that business is overshadowed by pleasure.

Tuesday morning's meeting was devoted to roll-call, after which an early adjournment was taken to enjoy the surroundings and recover from the effects of a long train journey. Golf practice occupied the attention of aspirants for tournament honors, while the ladies visited Monterey in automobiles.

Tuesday afternoon the party were the guests of the manufacturers in an automobile trip over the seventeen-mile drive, refreshments being served at the Pebble Beach Lodge. From every sign the convention will be the most successful held in the history of the organization.

PACIFIC COAST A. I. E. E. MEETING.

The second annual Pacific Coast meeting of the American Institute of Electrical Engineers opened with an unexpectedly large attendance on Tuesday, April 25th, at the Hotel Alexandria in Los Angeles, and is in session as we go to press.

On Tuesday morning Mayor Alexander of Los Angeles welcomed the visiting engineers and offered them the city's utmost hospitality. The ladies in the party were taken to Casa Verdugo in automobiles, where luncheon was served. The technical sessions at 10 a. m. and 2 p. m. were devoted to hearing and discussing several papers of which more extended notice will be given in our next issue.

Late in the afternoon adjournment was taken in order that a trolley trip be taken to Redondo, where dinner was served, after the new steam turbine plant of the Pacific Light & Power Company had been inspected.

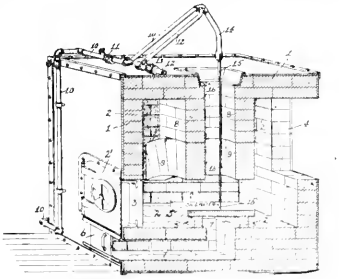
TRADE NOTES.

The Cutler-Hammer Manufacturing Company have moved their Chicago offices from the Monadnock Block to more spacious quarters in the People's Gas Building, 122 South Michigan Boulevard.

The Pelton Water Wheel Company has sold to the Rogue River Electric Power Company a 400 h.p. impulse wheel to be direct connected to the generator, which is to supply current for use in the construction of their new hydroelectric plant on the Rogue River, 30 miles above the present installation.

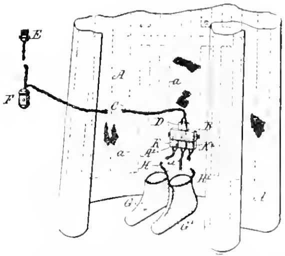
PATENTS

989,828. **Liquid-Hydrocarbon Furnace.** Julius H. Becker, San Francisco, Cal., assignor of one-half to J. H. King, Oakland, Cal. A liquid-hydrocarbon furnace comprising a shell inclosing a combustion chamber, said shell having in one of its sides a door-controlled opening and in its opposite side a flame exit; a removable firing plate in the lower portion of the chamber, of dimensions adapting it to be inserted and



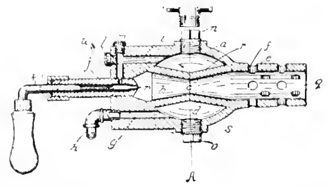
removed through the door-opening; a flue depending from the top of the shell into the combustion chamber and spaced from the walls thereof, said flue opening out above through the top of the shell and opening out below over and spaced from the firing plate; spaced arches springing from the shell walls and supporting the lower end of the flue; and means for delivering the liquid fuel into said flue so that it will fall and spatter upon said plate.

990,206. **Fo-t-Warming Attachment for Electrothermal Garments.** Phyllis E. Charles, Portland, Ore. Filed Oct. 12, 1910. The combination with a source of electrical energy, and with a garment wired with a circuit for the diffusion therethrough of electrical currents—of a contact block fixed to the fabric of said garment and receiving the terminals of its



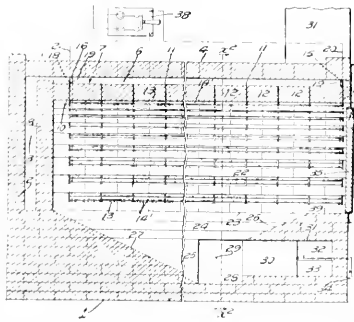
circuit wires,—a detachable contact block or plug and flexible electrical connections therewith, and separable foot-wraps, or boots, wired also with circuits for the diffusion therethrough of electrical currents, such circuits having their terminals in said detachable block or plug, whereby a common current may be directed through the body and feet of the user.

989,745. **Hydrocarbon-Oil Burner.** Fred Wissinger and William E. Wilkinson, Portland, Ore. A hydrocarbon burner comprising a casing having a double truncated tube spaced from the walls of said casing, the truncated portions of the tube meeting at approximately the center to provide a choke, the space surrounding the tube forming a generating chamber, the said casing having two extensions connected by a web having an opening, one of said extensions having an opening which communicates with the generating chamber to supply fuel thereto, the other said extension and the web having a duct which communicates with the generating chamber and the opening in the web, a valve casing fitting in the opening in the web and formed with a perforation which registers with the duct, said web and the inner end of the valve casing being spaced from the end of the truncated tube to admit air to the



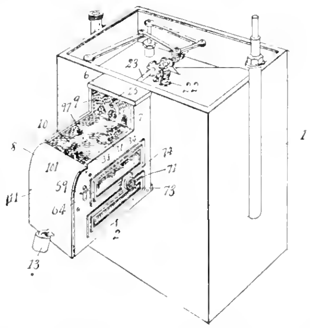
latter, a needle valve operating in the valve casing, and a tubular extension on the casing in line with the double truncated tube, said tubular extension having a series of openings for the admission of air to the vapor.

989,960. **Electrical Crematory.** Lawson H. Giddings, Pasadena, Cal. An electrical crematory comprising a retort composed of bricks in staggered courses forming open grooves,



electrical resistances in the grooves, said resistance being exposed to the interior of the retort, and hangers of heat-resisting material extending between the bricks and into the grooves to support the resistances.

990,125. **Bill-Delivery Mechanism for Meters.** Richard W. Gallagher, San Francisco, Cal., assignor to Automatic Billing Company, Los Angeles, Cal. In an apparatus of the character described, the combustion, with meter gearing, of a recording wheel, a gear wheel for intermittently advancing said



recording wheel, means for moving the recording wheel bodily to take a record therefrom, an operative connection between said gear wheel and gearing, inoperative when the wheel has been so moved and means adapted to be brought into operative connection with said gear wheel when the latter is out of operative connection with the gearing to turn said wheels to zero.

INDUSTRIAL

NEW OIL BREAK SWITCHES.

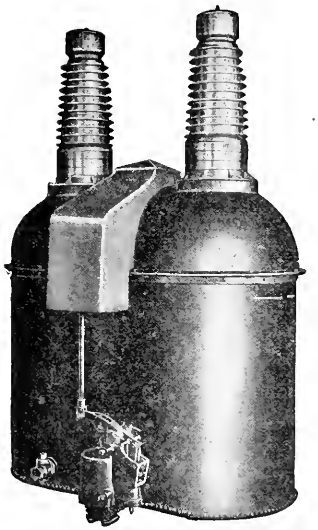
The modern tendency in the electrical field has been towards the use of apparatus of larger and larger capacities. This has necessitated the development of devices capable of opening large currents at high voltages without introducing disturbing effects on the system. Since the oil break switch is the only known commercial device which will accomplish this, a discussion of a new form which the General Electric Company has recently developed to meet requirements in modern large capacity stations employing voltages from 22,000 to 110,000, will be of interest.

The body of the switch consists of a heavy boiler iron tank. This contains the oil and also supports the switch leads and operating parts. The tank rests directly on the floor and no cells or barriers are required. The switch is built in single-pole elements; i. e., a three-pole switch consists of three elements, each element constituting a cell in itself. This reduces the floor space necessary and obviates the cost of constructing cells to contain the switch.

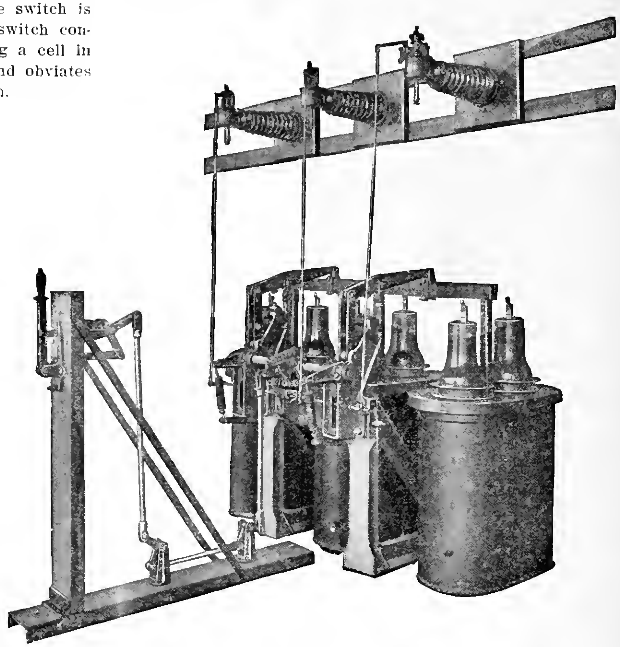
face. The bushings after assembly are filled with special insulating compound of high dielectric strength.

The design of the contacts is such that on rupturing the circuit the arc always takes place on the upper extremity of the moving contact and on the flared portion of the stationary one, so that the actual current carrying contact surfaces are always protected. At rated loads the switches have a low temperature rise, in no case exceeding 28 degrees Centigrade.

The switches can be operated by hand, by a solenoid mechanism requiring a direct current source of power, or by a diaphragm mechanism using compressed air, and are arranged for either non-automatic or automatic operation on overload. The weight of the moving parts is counterbalanced by adjustable tension springs, so that the switches close



Single element of Form K 15, 100 amp., 110,000 v. oil break switch, solenoid operated



K-10, 300 ampere, 45,000 volt oil break switch, hand-operated with series relay mechanical trip.

In general the construction of these switches is similar to that of the other Form K oil break switches made by the General Electric Company, in that they have a vertical motion of the contact rods and a double break for each circuit. When the switches are opened the contact blades move rapidly downward, opening the circuit in oil. The switches have ample air space above the oil and are suitably vented to prevent oil from being thrown out when the switches are opened on extreme overload or short circuit.

With the exception of some of the lower voltages, where one-piece porcelain bushings are used, all bushings are of the built-up type, similar to those which have been successfully used for some time on the General Electric 45,000-volt oil break switch and on high voltage transformers. The built-up bushings have porcelain ends, intermediate rings of compound with treated fibre washers between the latter. The washers are of large diameter and increase the creepage sur-

easily and open without excessive jar. The different kinds of operating mechanisms are as follows:

The hand mechanism consists of a handle or operating lever mounted on a panel or other suitable support. In closing the switch the lever moves through an arc of 180 degrees. It has a very powerful toggle which exerts the maximum power at the end of the stroke and makes it possible to close the switch contacts under heavy spring pressure. On all non-automatic mechanisms, provision is made for adding overload protection at any time without difficulty. The mechanism for overload operation has a trip free from the handle feature so that the switch cannot be held closed on overload or short circuit.

For solenoid operation the operating handle, bell cranks and pipe connections are replaced by one or more solenoid mechanisms, each of the latter being provided with a large coil to close the switch and a small coil to trip it. A control

relay is used to close and to open the closing coil circuit, the control switch thus having to handle the small current of the control relay coil only. The trip coil of the solenoid operated switch is energized by a hand operated control switch or by an overload circuit closing relay when used. Solenoids are made for use on 125, 250 and 650 volts direct current.

For remote control, where a convenient source of direct current for operating the switch is not available, air operated mechanism can be used.

To provide for the automatic protection of apparatus, under abnormal conditions of overload or short circuit, two methods, by series relays (series relay trip) or by current transformers (current transformer trip), are commonly employed. A selection between them and the various combinations under each depend upon the conditions of operation in the particular case as well as upon the cost of installation.

Single element of Form K-15, 100 ampere, 110,000 v., oil break switch, pneumatically-operated.

Series relays are similar to standard switchboard relays with or without bellows attachment for instantaneous or time limit operation respectively. They are all single-pole, and each is mounted on a post insulator. The post insulator is clamped to a base which may be mounted on the side wall of the station or to a support directly above the switch. The relays are connected in series with the line, one or more being used according to the system employed.

Series overload relays with mechanical trip with or without the inverse time limit feature are used with hand operated switches where a convenient source of direct current for tripping is not available. The relay mechanism acts directly through a treated wooden rod and tripping shaft upon a small auxiliary toggle which releases the main switch toggle and opens the oil switch.

The series overload relay with electrical trip is similar to the ones just described except that the wooden connecting rod actuates a small switch and closes an electrical circuit through a trip coil which in turn opens the oil switch. This method of tripping is used with solenoid operated switches. It may also be used with the air operated switches, being connected in a manner similar to that just described, except that low tension alternating current is used to actuate an electrically operated air control valve.

High voltage current transformers when accurate and reliable, are more expensive than series relays, and are therefore seldom used for tripping switches except when it is necessary to use the current transformers with wattmeters, watthour meters, or reverse current relays. In general, the operation of these switches by means of current transformers is the same as with lower voltage apparatus using standard switchboard relays, and varies only in the combinations for the different operating mechanism.

When current transformer trip is used with hand operating mechanism for "K-10" and "K-15" switches, it is necessary to have a trip coil on the oil switch mechanism. Provision for this is made so that it may be added at any time without difficulty. With direct current trip, a single direct current coil is used. With alternating current, a similar coil or coils are used.

When current transformer trip is used with solenoid operated mechanism, direct current is available and circuit closing relays are used connected in parallel with the opening side of the control switch and the tripping coil of the solenoid mechanism.

When current transformer trip is used with air operated mechanism, it is customary to have the trip coil on the switch mechanism. Circuit opening relays are used with a single trip coil in the secondary of the current transformers and entirely separate from the alternating current control circuit for the electrically operated control valve.

Automatic operation on reversal of current is obtained by the use of reverse current relays in the secondary of current transformers and combinations are similar to those described under current transformer trip.

The "K-10" switch is used on systems with voltages of from 22,000 to 110,000 volts on which the combined normal energy delivered to the bus is not greater than 20,000 kilowatts. The "K-15" oil switch is used on systems with voltages of from 70,000 to 110,000 volts on which the combined normal energy delivered to the bus is not greater than 50,000 kilowatts.

TRANSMITTERS AND RECEIVERS IN THE MAKING.

The average telephone user gives very little thought to the why and wherefore of the transmitter and receiver. He thinks of the telephone as a national and personal convenience, but seldom has any conception of what the instrument really is. To get the wide range of notes from a stringed musical instrument a large number of vibrating strings are necessary. How much more wonderful then are the little telephone transmitter and receiver with their single vibrating diaphragm. These instruments receive and transmit the human voice over miles of wire under a multitude of conditions. Not only will they transmit and receive the comparatively few notes of a piano, but they will reproduce the individual characteristics of the human voice over great distances.

The manufacture, inspection and testing of these instruments forms an interesting story, and the accompanying illustrations show some of the processes involved.

Some idea of the magnitude of this branch of the telephone making industry may be had from the statement that over one million pair of transmitters and receivers were manufactured during 1910 by the Western Electric Company alone. In producing this great number of instruments fifteen hundred tons of brass, three hundred tons of steel and at least two hundred tons of rubber and other raw materials, including thirty-five million screws, were consumed. All of this apparatus was made in the big factory fronting on West Street, New York City, which ranks second only to the immense Hawthorne works of the same company.

The Transmitter.

The transmitter is one of the most delicate pieces of apparatus on the commercial market. Several of its parts must be held to such close dimensions that the Western Electric Company was confronted with the problem of making

not only the telephone instruments but much of the necessary testing apparatus and measuring instruments. Such instruments as those used to measure the thickness of the mica, which is held to within three ten-thousandths of an inch, were made in the company's own shops. It is interesting to note that in order to secure mica that can be cleaved to such small dimensions it is found necessary to import it from India and that because of the difficulty met with in separating even this selected mica into exactly the right dimensions fully 80 per cent is rejected.

Testing the Transmitters.

Another important operation is the manufacture of the carbon granules contained in the transmitter button. These granules must have exactly the right degree of hardness, otherwise the tone of the transmitter will be affected. They must be of uniform size, otherwise the transmitter would have a tendency to pack, and, in addition, just the right amount of carbon granules must be used. The carbon is measured in a cup having a steel cut-off, which insures the correct volume. In order to see that the carbon is running with the right ratio of weight to volume a certain percentage of the buttons are weighed by means of a delicate balance and a close check is kept on them.

The front and back electrodes are also made of carbon. Each is as highly polished as a steel mirror and each one must have just the proper degree of hardness, otherwise pitting would result from the passing currents, which would affect the transmission and might result in packing.

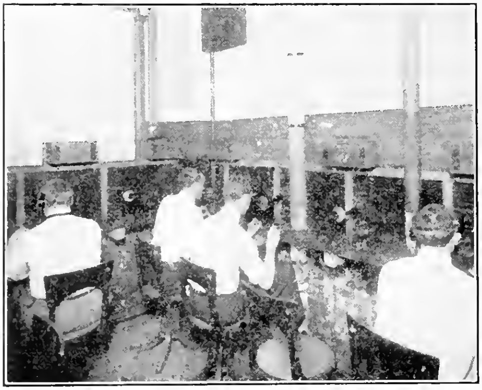
Testing.

It testing most telephone apparatus, such as generators, drops, relays, etc., it is possible to measure their efficiency in concrete terms and with practically no human factor entering into the results of the tests. Since the primary function of a transmitter is to transmit the human voice, it becomes necessary in testing their efficiency to make use of the human voice, and thus the human element enters. The volume and articulation test is made over a circuit line which is the equivalent of an actual line two hundred miles in length. The operator standing at the receiving end signals back to the man testing the transmitter, telling him whether the volume and the articulation is satisfactory. In order to eliminate carelessness as far as possible from this test the inspectors do the talking and receiving in pairs. In the morning one does the talking while the other is receiving, and in the afternoon the operation is reversed. By long training at this work these men are able to pick out a variation in efficiency to a fraction of one per cent. Any transmitter that does not measure to the standard transmitter must go back for readjustment.

Besides the transmission test, the transmitters must also survive what is known as the mechanical inspection, which includes a minute, detailed inspection of every one of the piece parts going to make up a section of the instrument, each group of parts as assembled, and finally the completed instrument.

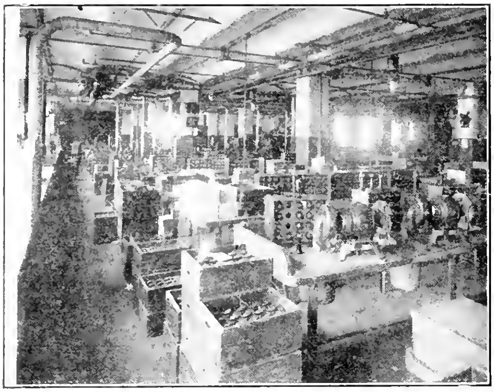
The Receiver.

The receiver is another delicate piece of electrical apparatus and successfully to manufacture it requires special machinery and skilled labor. The steel from which the magnets are made must be carefully chosen and then comes the proper tempering and magnetizing of it. Formerly skilled men



Final Inspection of Transmitters.

were employed to determine when the steel was heated to just the proper temperature for emersion, but after years of experiment a way was devised and placed into effect by which "human error" was eliminated. Today the temperature of the annealing furnaces is kept at a pre-determined uniform heat by means of an electrical indicator. By placing the steel in the furnace for a prescribed time the exact conditions for producing the fine degree of temper are obtained.



Final Inspection of Receivers.

Another important member of a receiver is the vibrating diaphragm, whose thickness must be held to within two thousandths of an inch. The space between the ends of the pole pieces and the diaphragm must be held to a dimension as close as .015 in., for any greater dimension would decrease the efficiency of the receiver, and any less dimension would make the instrument so delicate that hard usage would put it out of commission.

The receivers are given the same rigid talking and mechanical tests as those given to the transmitters mentioned

above. Maximum efficiency over the longest possible period of service both in the transmitter and receiver is the result of the pains taken by the company in the manufacture of this apparatus.

THE LARGEST REINFORCED CONCRETE FACTORY IN PHILADELPHIA.

It has just been announced that The Electric Storage Battery Company at 19th Street and Allegheny Avenue has closed a contract for the design and construction of a new reinforced concrete building which will be the largest manufacturing building of this type in the city. This addition to its present plant will be a building approximately 300 ft. long by 115 ft. wide, six stories high, with a one story triangular extension about 80 ft. by 120 ft. These buildings will be constructed by the patented system of mushroom reinforced concrete construction and will be designed to meet the particular demands of this company.

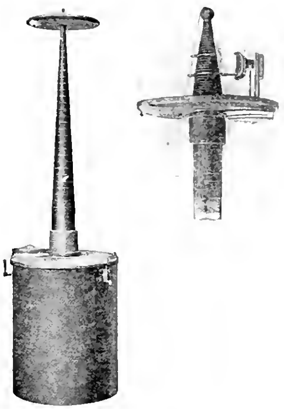
The demand for storage batteries of this company's manufacture has increased to such an extent that it has been necessary to provide additional manufacturing facilities at once.

The Electric Storage Battery Company has recently closed contracts with many of the large electric lighting companies for enormous "Exide" storage batteries for emergency service, and these large orders together with the enormous demand recently made upon the company for the "Exide" and the new "Ironclad-Exide" electric vehicle batteries have greatly increased the business of the company.

These new buildings will be of the most up to date design, strictly fire-proof, will be provided with the most modern machinery and the best facilities for the convenience of its employees. The construction of these buildings is to start at once to be completed during the Fall and will give employment to a large additional force of workmen.

HIGH TENSION ELECTROSTATIC VOLTMETER.

For the measurement of high potentials, of 25,000 volts or more, the common practice is to use voltmeters operating on the electrostatic principle. The current required to operate an electromagnetic voltmeter would at high pressures require a kilowatt or more of energy, while a voltage transformer to



reduce the voltage on the meter to a safe value would be excessively large to secure the proper insulation. An electrostatic voltmeter, on the other hand, consumes practically no power, and its construction can be made more simple than that of a voltage transformer for high voltage.

The latest type of electrostatic voltmeter, recently brought out by the Westinghouse Electric & Mfg. Company, Pittsburg, Pa., contains several unique features not found in any previous types. These features tend to make the instrument entirely free from the influence of exterior static fields and provide ample insulation for voltages as high as 200,000 or more without adding greatly to the size of the device.

The mechanism consists of a condenser type of terminal and a measuring condenser element mounted in a sheet iron tank with cast iron cover. The current carrying parts are immersed in oil, which allows the instrument to be compact by increasing the dielectric strength between the measuring surfaces, and also acts as a damper and produces dead beat readings.

The terminal consists of concentric alternate insulating and conducting layers, which form in effect a large number of condenser in series. The moving element, which is in parallel with several condensers at the grounded end of the series, consists of two closed cylinders carried on opposite ends of a cross beam hung by a glass shaft from a special ball bearing. The cylinders move between two curved plates one attached to the tank and the other to an outer layer of the terminal.

When the core of the condenser type terminal is connected to one side of the high tension circuit, and the tank is connected to the other side, grounded, the total difference of potential is divided up among the various condensers in series, and charges of opposite polarity, proportional to the voltage, are induced on adjacent faces. Each cylinder of the moving element is charged oppositely to the curved plate nearest to it, and an attraction exists between the charges on the cylinders and on the plates, which tends to cause rotation of the moving element. This rotation is opposed by a spiral spring so that the deflection is a function of the charge and consequently of the voltage. The deflection is indicated by a pointer carried by the shaft and read on a horizontal scale. The scale is provided with a mirror to prevent parallax, and reads both in volts and in proportional divisions.

By short circuiting layers of the condenser terminal, a higher difference of potential exists across the remaining condensers, and the deflection is correspondingly increased for low voltage. Provision is made for reading full scale at one-half and one-quarter voltage; the necessary connections being made without opening the case.

The use of the Westinghouse condenser type terminal makes a very compact instrument. A 200,000 volt meter, for instance, is 3 ft. in diameter and 3 ft. high, and the terminal projects 63 inches above the cover of the case.

NEW CATALOGUES.

In Bulletin No. 4816, recently issued by the General Electric Company, is described a new running light telltale board placed upon the market by this company, which affords a reliable means of indicating whether or not the running lanterns of an electrically lighted vessel are lighted.

The General Electric Company has just issued Bulletin B 3038, entitled "Electricity on the Farm." The bulletin is divided into brief chapters, each covering a specific use for electricity on the farm, the various descriptions of motor applications being accompanied by illustrations of electrically operated farm machinery in actual service. The section covering barn and field machinery includes description and illustrations of motor operated hay hoist, ensilage cutter, thresher, grist mill machinery, etc., while the chapter on electric drive for dairy apparatus shows the use of motor driven vacuum pumps for the operation of vacuum milking and cattle cleaning outfits, motor driven separators and churns. Other chapters deal with electrically operated refrigerating plants to meet the requirements of the average farm, the application of motor drive and auxiliary electrical devices in the farm workshop, and the possibilities of electric haulage for farm products.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Sacramento-Sierra Power & Water Company has been incorporated by C. C. Chapman, C. L. Barsotti, John Muldoon, Dudley Smith and C. J. Lancaster, with a capital stock of $2,500,000.

FINANCIAL.

SANTA BARBARA, CAL.—The Santa Barbara Gas & Electric Company has decided to ask the stockholders to ratify a proposition to put out a bond issue of $1,000,000, the measure being voted at the directors' meeting held in this city last week. The new bonds will bear 6 per cent interest, and the plan is to substitute them for the 5 per cent issue of the same amount which it has been found difficult to float. The bonded indebtedness of the company will not be increased by the recent action, but a more attractive bond to investors will be offered. At the present time $680,000 of the 5 per cents are held as security for loans, there being no direct sale for them. All these 5 per cent bonds will be called in as soon as the new issue is on the market.

ILLUMINATION.

BAKER CITY, ORE.—The bond issue of $25,000 for the construction of an electric power plant has been passed.

PORTOLA, CAL.—The Portola Lumber Company is to provide the first electric lights and power to Portola.

SEATTLE, WASH.—Bids have been rejected and will be readvertised for an electric chassis for the lighting department.

SANTA ROSA, CAL.—The Sebastopol Light & Power Company has petitioned the Superior Court for permission to dissolve its corporate existence.

VICTORIA, B. C.—Hutchinson Bros. have secured the contract for the installation of the electrical system for the cluster lights on Fort street, to cost $1400.

SALEM, ORE.—The Board of Trade will hold a meeting for the purpose of deciding the question of installing cluster lights on the streets.

ROSEBURG, ORE.—The City Council has granted to W. F. Boardman & Co., of San Francisco, a 50-year franchise on the streets and alleys of Roseburg for gas purposes.

EUGENE, ORE.—Alvin Myers, engineer, Eugene, Oregon, has just completed construction of a municipal electric light plant for his city at Waterville, costing approximately $200,000.

LOS ANGELES, CAL.—The Board of Supervisors has denied the application of the Southern California Gas Company for a blanket franchise covering Los Angeles County.

WALLA WALLA, WASH.—The Pacific Power & Light Company announces that work will be started immediately on the construction of a transmission line from this place to Dayton, to cost about $50,000.

PASCO, WASH.—Plans have been completed by the Pacific Power & Light Company for the construction of a new power and switching station; work will commence about June 1.

RICHMOND, CAL.—The Oakland Gas Company, which supplies Richmond, has reduced its rate from $1.50 to $1.25 per 1000. The company will at once take steps for the betterment of its service and the extension of the mains to all parts of the city.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company plans to inaugurate a development of electric power in the Lewiston-Clarkston project, which will result in the early construction of an electric railway.

MONTESANO, WASH.—An election will be held here this month to decide the question of purchasing the plant of the Montesano Water & Light Company. The proposed issue will call for $125,000.

PASCO, WASH.—An election will be held to decide on a $50,000 bond issue, $30,000 to be used for the purchase of the city water plant from the Pacific Power & Light Company, and $20,000 for other improvements.

NORTH YAKIMA, WASH.—City Engineer Doolittle has presented an estimate of $250,000 for the construction of the proposed new municipal light and power plant. The complete plants for the proposed system will be completed by June 1.

CLAREMONT, CAL.—The City Council has passed an ordinance granting to the Pacific Light & Power Company a franchise for a period of 50 years to erect poles, etc., along Mills avenue from N. First to the north city limits.

SEATTLE, WASH.—The offer of P. H. Hebb of Tacoma to sell his White River property as a power site to the city of Seattle has been turned down. The purchase price is considered too high.

HAWTHORNE, CAL.—At an election held here to vote on the question of establishing a lighting district to give Hawthorne street lights, the proposition carried by a large majority. The Supervisors will advertise for bids.

TACOMA, WASH.—The Tacoma Gas Light & Power Company, owners of patents for producing illuminating gas from garbage, has applied to the municipal commissioners for franchises that will enable it to put in a system equal in capacity to the city's present coke gas supply system.

MONROE, WASH.—The Everett Gas Company has decided to extend its gas mains to Monroe. Application for a franchise will be made at once to the City Council. The lighting company will put up a two-story cement or brick building for office purposes and as a transformer station, making an investment of about $30,000.

WILLOWS, CAL.—Fast work is being done on the Willows gas plant of the Northern California Power Company. More than a mile of mains have been laid and the remaining four miles will be put down within the next four weeks. Gas is promised by June 1. It will be sold to private consumers at $1.50 the 1000 cubic feet.

WALLOWA, ORE.—The McCully-Rumble Power Company plans to develop 1000 h. p. on a newly acquired power site on the Wallowa River 20 miles below this place. Among the plans of the new company is to purchase all franchises in this and Union counties to supply electricity for power to all rural districts in this vicinity and to furnish light and power between Joseph and La Grande.

BAKERSFIELD, CAL.—A. E. Wishon, assistant general manager of the San Joaquin Light & Power Company, announces a reduction of 25 per cent in all electricity charges effective in July. Mr. Wishon says: "July 1 we will have power from our new generating plant at Crane Valley, into Bakersfield, and this will enable us to furnish electricity to all consumers cheaper than we are doing now, and accordingly our charges for the same will be reduced. The reduction is general and all users of electricity will benefit by it."

NEWPORT, WASH.—Arrangements have been completed for the establishment of a line from the Newport sub-station of the Northern Idaho & Montana Power Company to Priest river, and the necessary equipment for same has been ordered. The proposed line will carry 11,500 volts and will furnish Priest River with lights.

TACOMA, WASH.—George Milton Savage of Nisqually Construction Company, Savage-Scofield building, announces that warrants in the sum of $1,074,938.74 issued against the light and water fund to pay Hans Pedersen, a Seattle contractor, for constructing the second unit of the municipal hydroelectric plant at Nisqually River, have been successfully disposed of to Eastern investors.

NORTH YAKIMA, WASH.—H. J. Doolittle, city engineer of North Yakima, has made a thorough study of the preliminary plans for the proposed municipal light and power plant, and states that he will be able to furnish light and power to the consumers at a much lower rate than that charged by the company now furnishing light to the city. Mr. Doolittle will present complete plans to the council on June 5 for the plant which will cost $250,000.

SACRAMENTO, CAL.—Governor Johnson has signed an Assembly bill compelling gas companies, electrical companies and other concerns engaged in the business of furnishing heat or such things to sell those commodities to persons desiring them. The measure provides that in case of refusal the applicant, after ten days, shall be entitled to collect $50 from the company and the sum of $5 per day for each day thereafter that the gas, electricity or heat is denied.

MARYSVILLE, CAL.—Paul Downing, the engineer of electrical construction of the Pacific Gas & Electric Company, states that the present flume and ditch system carrying water for eight miles around the sides of a mountain to reach the Colgate plant east of here is to be abandoned. Instead a big tunnel will be pushed through the mountain. Another improvement to be made is the substitution of steel towers for the present poles on the main transmission lines from Colgate to San Francisco Bay.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company was assessed illegally when the County Assessor taxed it doubly in 1908 for a city street franchise as a penalty for its not paying that tax in 1907, according to a decision rendered by Judge Wilbur in the suit against the county. The court held that the franchise under the State law which was taxed included the rights of the corporation to use the city streets, and the County Assessor had no right to assess the corporation for its street franchise. The corporation was assessed in 1907 for both the State and city franchise, but later had the latter assessment canceled. In 1908 the Assessor taxed them doubly, claiming that the tax the year before had been evaded. The corporation paid under protest and then proceeded to bring suit.

LOS ANGELES, CAL.—The first step in the city's plan to organize a power and light bureau for the purpose of developing the electrical energy along the line of the aqueduct and constructing the plants for generating and distributing the light and power derived therefrom has been taken by Mayor Alexander. He has sent to the public service commission, a communication urging the immediate organization of the bureau and the development of the resources that belong to the city. Mayor Alexander points out four separate propositions which the commission might undertake, embodying four distinct places along the aqueduct where power may be developed. These are San Francisquito No. 2, San Francisquito No. 1, San Fernando and Haiwee. The amount of electrical energy that could be derived at these four places is, respectively, as follows: 32,000, 60,000, 9000 and 10,000 h.p. The respective cost would be as follows: $2,300,000, $3,300,000, $750,000 and $1,500,000.

TRANSMISSION.

GREENVILLE, CAL.—President O. C. Pratt of the Indian Valley Power Company, with Mr. Lang of Stockton, have inspected the local electric light plant and are considering plans for the extension and enlargement of the present installation.

RENO, NEV.—The Truckee River General Electric Company is seeking a right of way for a high-tension power line from its new plant near Verdi to Virginia City and has commenced a condemnation suit in the District Court to secure the possession of the same. The suit has been filed against Botholomeo Chilleri.

JACKSON, CAL.—Announcement is made here that the Sierra Blue Lakes Power Company has decided on a location for its dam to be constructed to form a reservoir in the valley below the mouth of Blue Creek. The dam, it is stated, will be erected at a point a mile and a half below the mouth of Blue Creek. It is proposed to make it 800 feet high. The reservoir will be the entire valley at the mouth of Blue Creek.

OROVILLE, CAL.—Leo Van der Naillen will resign as manager of the Oro Water, Light & Power Company to accept the position of general manager of a power company with a capitalization of $10,000,000, which will be incorporated by the principal stockholders of the local company. The new company will carry power to San Francisco and Sacramento. The new company of which Van der Naillen will be general manager will be incorporated for the purpose of developing the power proposition in Plumas County now owned by stockholders of the Oro Water, Light & Power Company, among whom are J. W. Goodwin, Luther Holton and James K. Moffitt, well-known financiers of San Francisco.

TRANSPORTATION.

HANFORD, CAL.—The Hanford & Summit Lake Railway Company will soon begin construction work on extending its line to Jamison, Cal.

FRESNO, CAL.—About half the Sunnyside car line has been reconstructed by the Fresno Traction Company, which began the work ten days ago.

CHICO, CAL.—The Northern Electric Company has applied to the City Board of Trustees for a franchise to put down double tracks on Main street.

CENTRALIA, WASH.—An ordinance has been introduced in the Chehalis Council providing for a franchise for the new Chehalis & Cowlitz Railway, to run 50 years.

FRESNO, CAL.—The Supervisors have passed an ordinance granting to the Summit Lake Interurban Railway Company a franchise in the county of Fresno.

SEATTLE, WASH.—L. G. Gray, a Seattle shipping man, and associates are seeking rights of way for an electric railway line through Bremerton, Charleston, Port Orchard, Union City, Sheltan and Clifton to Grays Harbor.

LOS ANGELES, CAL.—J. B. Rowray has resigned as superintendent of the northern division of the Pacific Electric Railway Company to become superintendent of the Northern Electric Railway, with headquarters at Chico. The change will become effective May 1.

ALAMEDA, CAL.—Industrial Agent F. W. Hoover of the Southern Pacific Company announced yesterday that the Alameda electric service on the south side line would start promptly on June 1, as announced some time ago by the Southern Pacific head officials. The north side of the loop will not be given an electric train service until the Oakland side of the present steam horse-shoe route is made over into a part of the electric system.

HELENA, MONT. It has been announced by J. H. White, manager of the Helena Light & Railway Company, that bonds in the sum of $100,000 for the purpose of double tracking the line from this city to the fair ground will be placed on the market.

SEBASTOPOL, CAL.—Hon. John D. Connolly has started a petition to the magnates of the Northwestern Pacific Railway Company to have the third rail extended from Monte Rio up to Camp Meeker and Occidental and a standard gauge train service operated thereon.

SAN RAFAEL, CAL. Work will soon be commenced on the building of the electric road from Petaluma to a landing on the bay near Marin Islands east of San Rafael. The road is to come by way of Novato and will reach the bay through the valley just beyond the Towne ranch—this side of McNear's point.

WENATCHEE, WASH.—L. W. Pratt, president National Realty Company, Bankers Trust Building, Tacoma, has asked for franchises for a street car system here and for a line to Leavenworth and Cashmere. He will bring Sound capitalists representing $20,000,000 to Wenatchee the coming week to look over the project he is endeavoring to promote.

GLENDALE, CAL. The Pacific Electric Railway Company has asked for a franchise for one track between Glendale and Burbank. The right of way will be wide enough for two tracks, however, and will be graded for a double immediately, but only only track will be rushed to completion. The cost is estimated at $222,000, and the line should be finished in three months.

PATEROS, WASH. O. A. Hoag, real estate man, has applied to the commissioners of Chelan county for a fifty-year franchise giving him and his associates the right to occupy a portion of the road between Chelan and Wenatchee and between Chelan and the boundary line of Okanogan county with an electric transmission line for lights and power and with an electric railroad.

VALLEJO, CAL.—Crews of the Vallejo & Northern Railway Company have been placed at work between this city and Suisun and the new line to be built between Vallejo and Sacramento will be ready for use when the new bridge across the Sacramento River at Sacramento is completed. The railroad is being constructed of the heaviest type of rails. Work on the bridge is expected to be finished by August.

SAN FRANCISCO, CAL.—Electrification of the lines between San Francisco and San Jose is planned by the Southern Pacific. This is a part of the announced plan to establish a four-track line between this city and Redwood City with a possibility that the four tracks will be extended as far as San Jose. However, plans for the immediate future have in contemplation only the extra tracking and the electrification of the line between here and points on the peninsula where the passenger traffic has increased so rapidly.

SAN JOSE, CAL. The first big construction plan for local electric railroads under Southern Pacific ownership will be a loop line of 15 miles connecting Alum Rock Park, Berryessa and this city. This is announced by F. E. Chapin, general manager of the local lines. The line will be double tracked and standard gauged, and will, it is certain, go into the park via the present narrow gauge route to the mouth of the canyon. From Alum Rock back to the city it will go further northward, tapping the Berryessa orchard region, and will be in a position to be a direct competitor in local service over five or ten miles of the route, which the United Properties must take to enter this city from the Oakland side of the bay. The cost of the proposed new route is estimated at between $500,000 and $600,000.

TELEPHONE AND TELEGRAPH.

MOUNT VERNON, WASH.—The City Council is planning to order all telephone, power and light wires underground in the business district.

PORT HILL, IDAHO.—Representatives of the Bell Telephone Company are working in this vicinity to secure subscriptions to warrant the extension of a telephone line to Port Hill from Bonners Ferry, to cost $1500.

SANDPOINT, IDAHO.—J. E. Barton, superintendent of the Pend Oreille forest reserve, has received word from the forestry department that the Pend Oreille forest will be allotted $5500 this year for improvements. A telephone service will be established and a trail road built.

TACOMA, WASH.—The Home Telephone Company of Puget Sound, W. D. Tyler, receiver, Home Telephone Building, will install local systems and connecting lines on roads between same in Fleet, Custer, Clinton, Lake Steilacoom Park, Interlaken, Lakewood, Lake Grove, American Lake and American Lake additions to Lake City, at an estimated cost of $60,000.

WATERWORKS.

BELLINGHAM, WASH.—A petition has been presented for the extension of water mains and the placing of fire hydrants on Electric avenue; cost about $4000.

BAKER CITY, ORE. At an election here the following bond issues were passed by the voters: The sum of $90,000 for water system repairs, $25,000 for a new reservoir and $45,000 for paying intersections.

ELGIN, ORE.—The water commissioner of the city has employed J. R. Thompson, 301 Couch building, Portland, to superintend the improvement of the water system of this place; cost to be about $10,000.

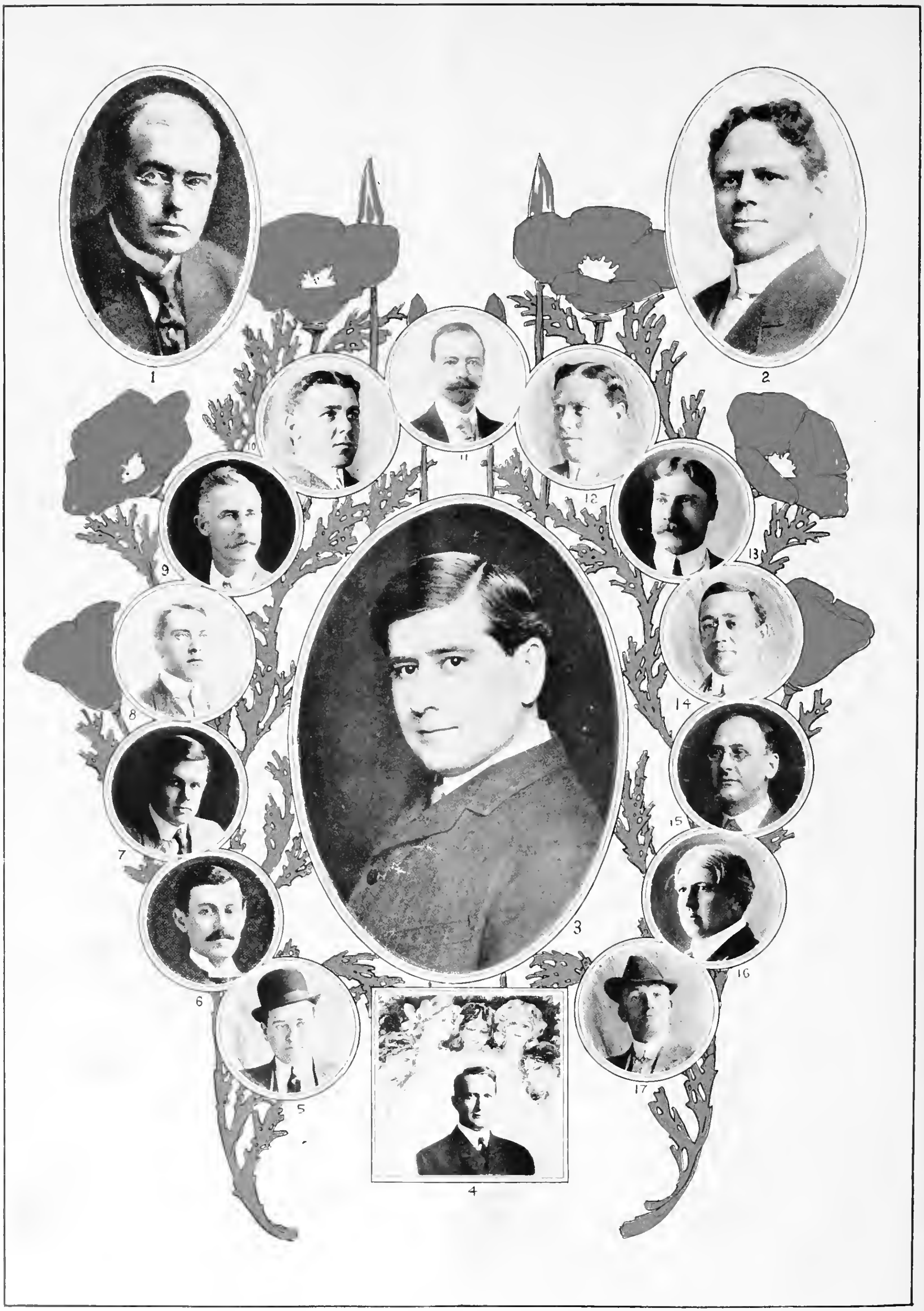
BELLINGHAM, WASH.—The petition presented by the people on Electric avenue for the expenditure of about $3700 for the installation of water mains has been accepted by the water board and costruction will start soon.

SANTA MONICA, CAL.—R. H. Dow, F. D. Butzer, C. A. Stils and others have taken desert claims in Inyo county and are organizing the Rose Spring Valley Water Company to develop artesian wells on its holdings.

OLYMPIA, WASH.—The new Northern Hospital for the Insane at Sedro-Woolley will have a water system costing about $20,000, with a double reservoir plant, having a storage capacity in excess of 700,000 gallons. The State Board of Control announced that Josiah H. Moore, of Seattle, has just completed the plans for this plant, the contracts on which will be awarded within a short time.

SAUSALITO, CAL.—Congressman William Kent is making preparations to install a water system at Willow Camp. His private secretary, J. E. Webb, has filed on the waters in steep canyon, and in a short time a contract will be let for building a concrete reservoir in the ravine. A pipe line several miles in length, will be run from the reservoir to the new hotel site, and a distributing plant will be installed through the district.

BERKELEY, CAL.—Action has been deferred on the water rate question until May 9 in order that the City Council may determine the value of the property owned by the water corporation, with a view to learning if returns on the investment at the present rates will not warrant a reduction. Manager C. L. Maloney of the People's Water Company, has presented a report to the Council showing gross profits to the company of $98,537.89 for last year's business on a total valuation of the system of $2,574,087.48 equal to 3 92/100 per cent profit on the investment. The receipts for the year were $255,115 and the expenditures $156,577.11.



1. Andrew Carrigan
2. Albert H. Elliot
3. C. C. Hillis
4. W. S. Berry
5. H. E. Sanderson
6. H. B. Squires
7. T. E. Burger
8. F. H. Poss
9. H. V. Carter
10. S. B. Gregory
11. C. E. Wiggin
12. W. L. Goodwin
13. John R. Cole
14. F. B. Gleason
15. T. E. Bibbins
16. H. G. Aylsworth
17. R. D. Holabird

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVI | SAN FRANCISCO, MAY 6, 1911 | NUMBER 18

Hotel Del Monte.

NATIONAL ELECTRICAL JOBBERS' CONVENTION

Never in the history of the old Santa Fe did a twelve-coach train leave the depot of the little village of Chicago carrying brighter light than the "Electrical Jobbers' Special" that left April 18th on its way to the big country west of the Rockies. One hundred and sixty-five men and women, men whose sterling worth was outshone only by the lustre of the beautiful women, whose wit and gaiety was in comparison as the flaming arc is to the miniature carbon. If we were to say Mesdames Low, Merrill, Hill, Sibley, Page, Cudmore, it would simply mean "Mrs. Everyone Else" that were leaders among the ladies.

That preparation had been made before leaving for a good time would hardly be questioned when the next morning at Kansas City, the party received their first "Daily Shock." Cudmore, the inimitable, was its editor, in fact what Cudmore was not on that trip would be easier to describe than what he was. From the rear platform of the observation car to the smoke from the engine, the party ruled supreme. Why mention individual names, Turner, Hemingray, Patton, Skeel, Billy Low, Downs, it's the same old story; each one of the entire party did his or her part and did it well. There was but one complaint that was heard from Chicago to Monterey; one prominent lady said: "The only objection that I can find with this trip is that we haven't had a scrap since we left Chicago."

A chronological history of the occasion requires a shifting of the scene to New York City, where several of the visitors assembled early in April to celebrate the quarter-centenary of Mr. B. M. Downs with the Brookfield Glass Company, those present being: Judge

PACIFIC COAST COMMITTEES

Ladies Reception.
W. S. Berry, Chairman
John R. Cole
E. N. Fobes
F. H. Poss
P. H. Aaron
Pacific Coast Ladies.

Trophies.
C. C. Hillis, Chairman
Albert H. Elliot

Tennis Tournament
F. B. Gleason, Chairman

Executive.
C. C. Hillis, Chairman
R. D. Holabird
W. L. Goodwin
Andrew Carrigan
F. B. Gleason

Program and Printing.
W. L. Goodwin, Chairman
R. D. Holabird

Pool Tournament.
T. E. Burger, Chairman

Golf Tournaments.
R. D. Holabird, Chairman
W. L. Goodwin
T. E. Bibbins
H. F. Sanderson

To Meet Train
H. V. Carter, Chairman
T. E. Burger
N. M. Graham

Trap Shooting.
C. E. Wiggin

Manufacturers
H. G. Aylesworth, Chairman
H. E. Sanderson
S. B. Gregory
H. B. Squires
F. H. Poss

Spanish Dinner
R. D. Holabird, Chairman
W. L. Goodwin
F. B. Gleason
Frank Fowden
C. C. Hillis

F. M. Debevoise, toastmaster; Frank Brookfield, secretary and treasurer Brookfield Glass Co.; R. G. Hemingray, president Hemingray Glass Co.; R. E. Gallaher, secretary New York Insulated Wire Co.; W. L. Fort, Western Electric Co.; George Elliott, Electrical World; R. B. Corey, president R. B. Corey Co.; E. W. Rockefellow, supply sales manager Western Electric Co.; J. B. Olsen, secretary Habirshaw Wire Co.; F. F. Downs, treasurer and manager U. S. Can. Co., Cincinnati; W. Joerger, General Chemical Co.; W. S. Benedict, Benedict & Benedict, Brooklyn; Herbert Sinclair, Star Porcelain Co., Trenton; T. L. Cuyler, assistant treasurer Postal Telegraph Cable Co.; Clarence Winter, lawyer; C. C. Hay, Ingersoll Rand Co.; A. H. Pease, president Hart & Hegeman Co.; A. T. Clark, secretary American Circular Loom Co.; Walter Cary, manager Westinghouse Lamp Co.; C. W. Price, Electrical Review; B. M. Downs, vice-president Brookfield Glass Co.

This pleasant occasion on the eve of the departure of many of the guests for the Coast was but a prelude to the entertainment provided en route to the Coast. As chairman of the entertainment Committee, Mr. H. H. Cudmore was ably assisted by L. W. Kittman, C. C. Sibley, T. C. Ringgold and Robert Kuhn.

More "Daily Shocks" were administered at Kansas City and the Grand Canyon, with Charlie Corrigan as sporting editor, J. J. Provost doing the society stunt, and Mat Austin as funny man. Aside from the many jokes and joshes perpetrated, it contained the program for each day and other matters of immediate interest. This sheet, like Joseph's coat, was one of many colors, alternating yellow, pink and green. Though thus short-lived, it may be revived at future meetings as the occasion arises.

An elaborate song-book was also distributed containing the words of many of the popular songs, whose singing enlivened many an hour of the journey. Throughout the trip card tournaments of all kinds were conducted with prizes for the winners, whether bridge, 500 or the great American game. For the devotees of the latter pastime the American Electrical Heater Co. of Detroit considerately supplied a score

A Group Enroute

or more sets of chips, whose lucky winners will long preserve them as mementoes.

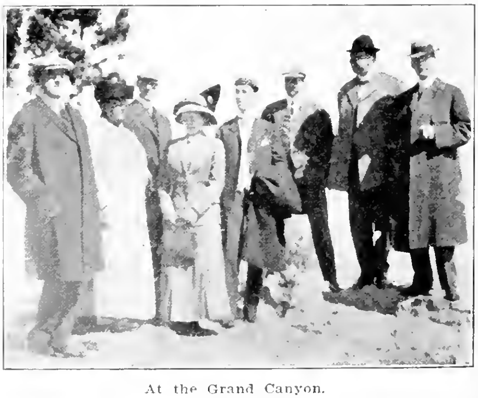
The observation car was converted into a keno palace, with cards for all comers, the house winnings buying flowers for the ladies. Informal vaudeville and music filled the interim.

Long before the desert appeared the Pullman porters considerately provided great paper bags for the ladies' hats, but neglected to provide like equipment for the masculine element, who were forced to dig off the dunes of sand which buried their blue serge suits. An insatiable thirst also seized the party as the desert was reached and was alleviated only by the wines of California. The novelty of the desert, its spaciousness and freedom, its shades and shadows, and

The Squaw and White Man.

its strange vegetation finally palled upon the travelers and they were again glad to return to the many amusements provided in the car.

Several stops were made en route, but the first of importance was the Grand Canyon of the Colorado, where the train arrived before breakfast on the morning of April 21st. The entire day was spent at the



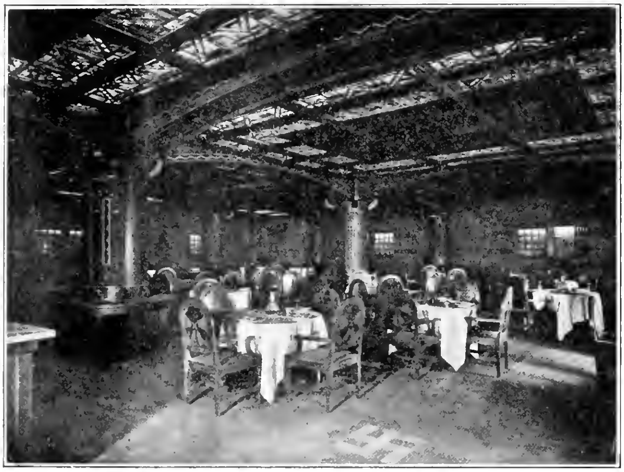
At the Grand Canyon.

Canyon, a number of the gentlemen and two ladies, Mrs. Scott and Mrs. Hill, descending to the river, some five thousand feet below. The rest of the party enjoyed the hospitality of the place and it was reported

that the "Squaw and White Man's Dance" was only second to the graceful and beautiful dancing of Miss Cotabish, who favored the party many times during the trip and to whom, if to any one, special credit should be given, for an ever-ready response to the request to entertain.

Leaving the Grand Canyon that evening it was midnight when they crossed into California. At ten o'clock on the morning of the 22d, Embassador H. V. Carter, Mr. Willis Booth of Los Angeles and a representative of the Journal met the party at Barstow. Which one of the welcoming party was the cause has not been settled at this writing, but certain it was that Old Sol covered his face with clouds, as much as to say, "I do not dare to witness what is to follow." The visitors of course were disappointed at not seeing sunshine in the land that has been made famous by it, but they were welcomed so warmly at Uplands by the ladies' reception committee, who escorted them through two of the largest orange packing houses in the State, all of which was intensely interesting to the visitors, that they soon forgot the shadow. Upon leaving the building they were presented with a small Japanese basket filled with fruit and a spray of orange blossoms with its sweet aroma.

Willis Booth.



Grill Room, Hotel Alexandria.

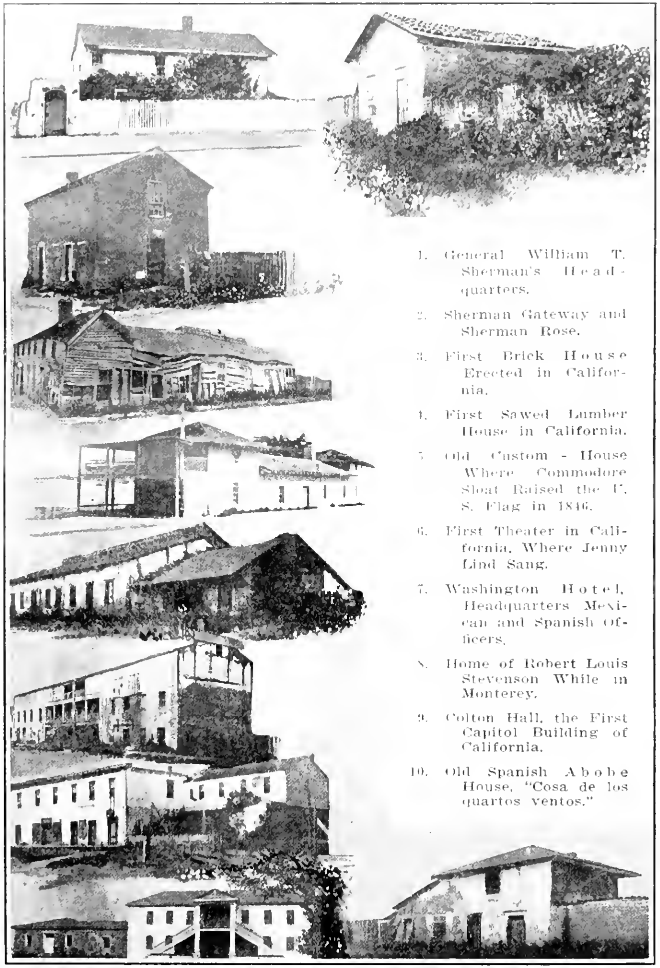
Automobiles were in readiness, furnished by that generous Southern Californian, Willis Booth, the party were taken over the seven-mile Euclid Avenue drive to the foot of old Baldy, where the contrast of the snows on the summit to the oranges and flowers of the valley was a subject of great wonder.

As the machines passed the High School at Ontario a bevy of school girls showered the occupants with roses. A stop was made at the Pacific Electric Heating Company's plant, where liquid refreshments were awaiting them at the entrance. A dozen or more young lady employees of the company, in all their white loveliness, served the most delicious fruit punch. California's native flower, the poppy, and the wild lupin were the decorations. After inspecting the many interesting departments of this, the largest electrical factory on the Coast, and many seeing for the first time the component parts of a heating iron, they were escorted into the show rooms, where the cases had been transformed into lunch counters, with cakes, fruits and dainties in abundance, electrical toasters were being worked to their full capacity; many electric percolators were temptingly displaying their fountains of amber to the admiring visitors. Coffee was served and a hearty "three cheers" given for the officers of the company and their employees. Unique booklets descriptive of the trip from Uplands to Los Angeles were presented to each of the party as they re-entered their automobile. This souvenir was treasured by all.

A delay of one hour in reaching Uplands caused the cancelling of the intended trip to old Mission San Gabriel and Pasadena, where special arrangements had been made for the opening of the Busch Gardens. The party arrived at Hotel Alexandria, Los Angeles, at 6:30 p. m. tired, a little dusty but very happy. As the guests entered their rooms they were greeted with another pleasant surprise, the Chamber of Commerce of Los Angeles, as it always does, anticipated their coming, and with their compliments had a basket of oranges and a bottle of wine there to greet them.

Sunday was devoted to trolley trips and other amusements not programmed. The directors of the Jonathan Club sent cards to each of the gentlemen and on Saturday evening a creditable Bohemian jinks was pulled off for the enjoyment of the visitors.

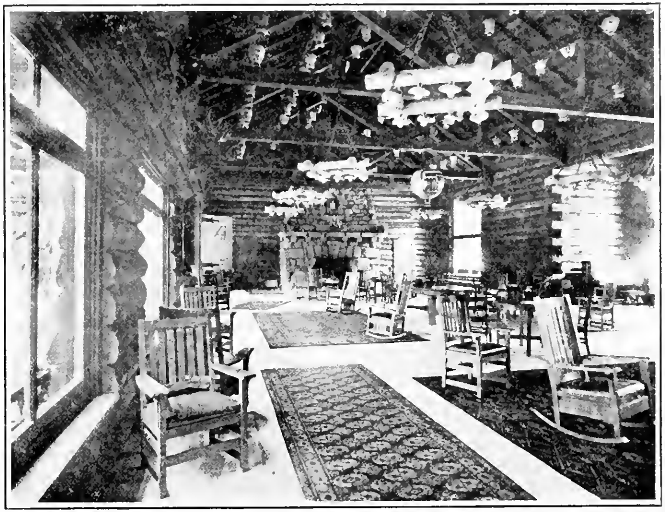
Monday morning at 8:05 the party returned to their old quarters on the "Electrical Jobbers' Special" and strange as it may appear, the sun remained in hiding. A short stop was made at Santa Barbara. The



1. General William T. Sherman's Headquarters.
2. Sherman Gateway and Sherman Rose.
3. First Brick House Erected in California.
4. First Sawed Lumber House in California.
5. Old Custom - House Where Commodore Sloat Raised the U. S. Flag in 1846.
6. First Theater in California, Where Jenny Lind Sang.
7. Washington Hotel, Headquarters Mexican and Spanish Officers.
8. Home of Robert Louis Stevenson While in Monterey.
9. Colton Hall, the First Capitol Building of California.
10. Old Spanish Abobe House, "Cosa de los quartos ventos."

Historic Landmarks of Monterey.

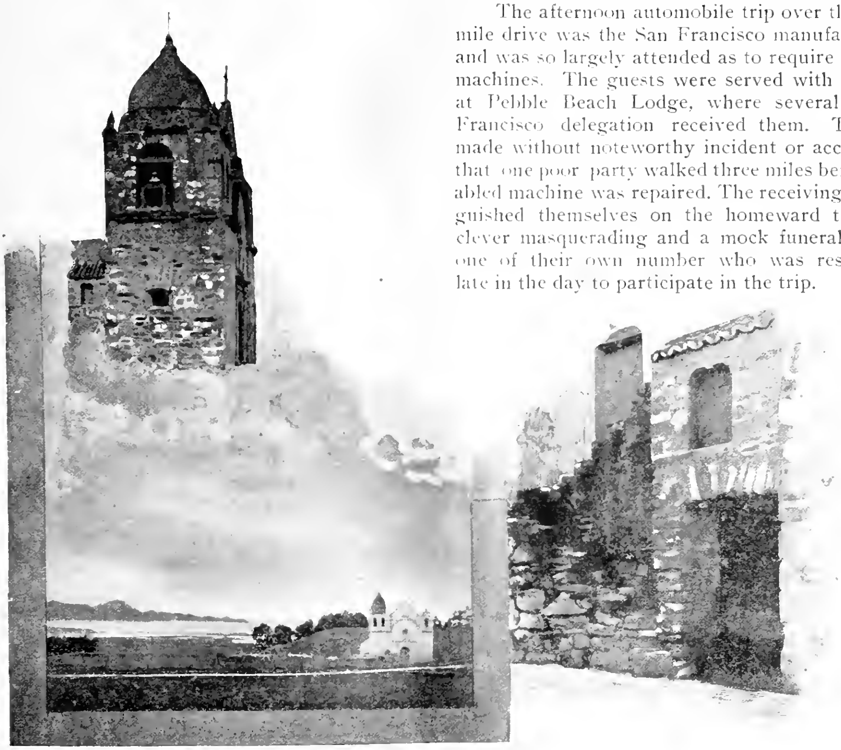
On the Seventeen-Mile Drive



Pebble Beach Lodge.

beauty of the Coast Line scenery will be remembered by all and at 10:30 the evening of April 24th, five days from Chicago, they arrived at their destination, Del Monte.

We have spoken of the entertaining committee and the pleasures and a few of the pleasant events of the trip, but to one man alone is due the credit of the perfect arrangements, the excellent service, and in a large measure the good nature of this party, and that is to the genial secretary of the National Association of Electrical Jobbers, Franklin Overbagh.



Carmel Mission.

This is the beginning of another story; "they're here!" Toot, toot, toot, bang, bang, bang, red fire, and in so short a time that the party hardly realized that they were out of their car than they found themselves whizzing in automobiles through one of the most beautiful parks in the world, lighted for the occasion, and greeted at the doors of Del Monte by the warm-hearted Western men and women. Who but H. R. Warner and his able staff of assistants could have in the short space of thirty minutes cleared that office of several truck loads of baggage and housed two hundred guests comfortably in their rooms as if they had been there a week.

The ladies soon retired, but the men—oh, where were they? Ask Billy, the bar-keep; Jimmie, the pool room man; Dick, the porter; the maze, the great oaks, the palms, or even old Monterey. They won't tell; neither will we, for we don't know. But one thing sure, an Eastern tenderfoot, male or female, out for a good time, will put a wild and woolly Westerner so far back in the woods, that it would take a globe trotter to find them. Is it any wonder the sun wouldn't shine?

By 10 a. m. Tuesday everybody was in evidence, the jobbers for alleged business, the ladies for pleasure, and the manufacturers for relaxation. The jobbers' first session was short and formal and soon freed them for enjoyment of the surrounding attractions. The ladies were piloted to the historic land marks of Monterey, returning in time for lunch..

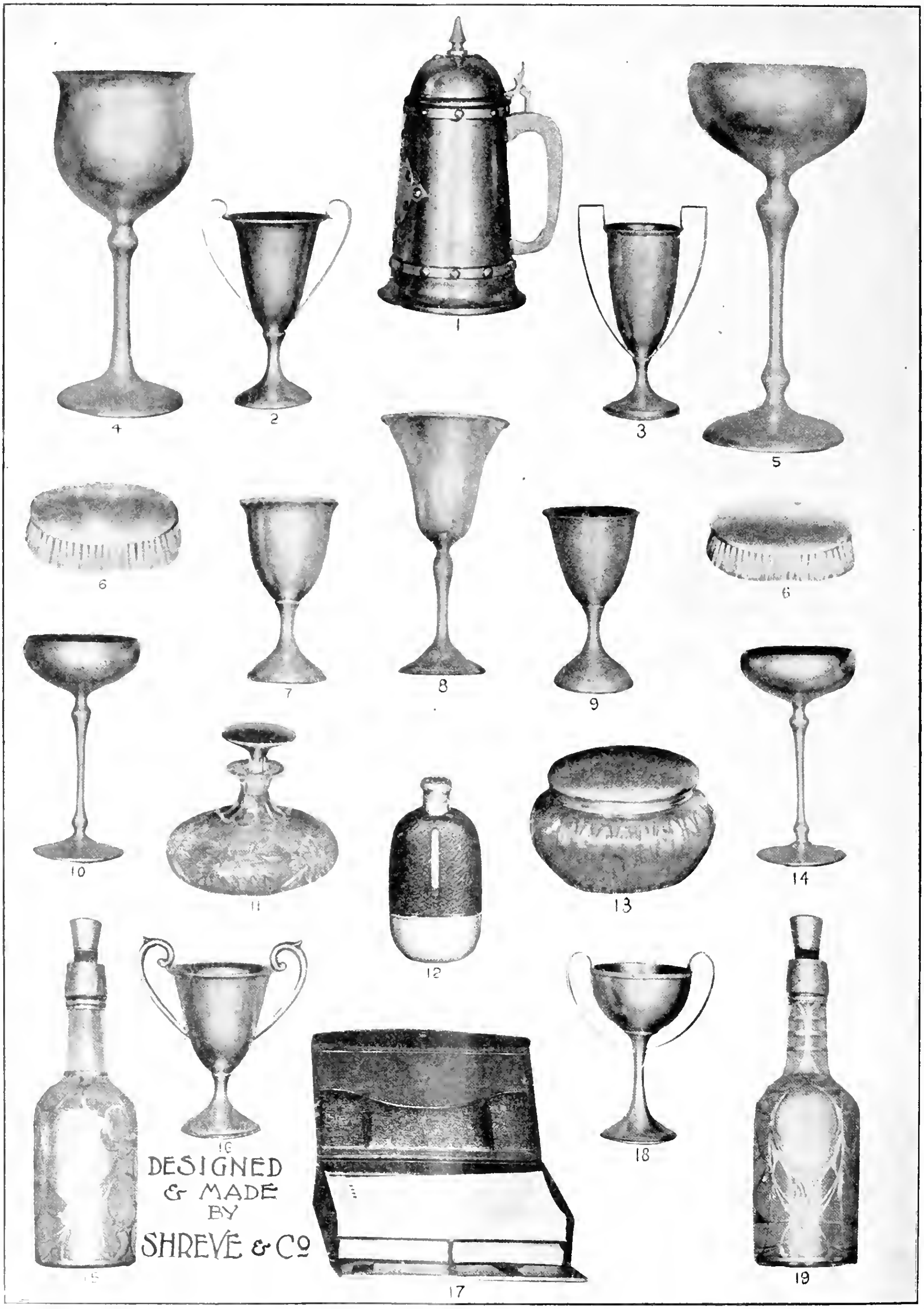
The afternoon automobile trip over the seventeen-mile drive was the San Francisco manufacturers' treat and was so largely attended as to require two relays of machines. The guests were served with refreshments at Pebble Beach Lodge, where several of the San Francisco delegation received them. The trip was made without noteworthy incident or accident, except that one poor party walked three miles before their disabled machine was repaired. The receiving party distinguished themselves on the homeward trip by some clever masquerading and a mock funeral in honor of one of their own number who was resurrected too late in the day to participate in the trip.

Tuesday evening a concert was given in the ball room by some of the more talented guests, who received the well merited applause of all present. A start was also made on the pool tournament. After concert suppers were enjoyed until an early hour on Wednesday morning, though the most irrepressible were not subdued until 3 a. m.

Wednesday morning, while the jobbers were in convention assembled, the ladies viewed the submarine gardens and the manufacturers played the qualifying round at golf. Unfortunately the phonographic records of the fruitless search for lost balls cannot be here reproduced, which is perhaps just as well.

Wednesday afternoon the jobbers played golf, the nineteenth hole soon becoming the center of attraction. The marksmen shot clay pigeons and the tennis enthusiasts started their games.

Wednesday evening before retiring for the night the sun peeped out and the picture that presented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DESIGNED & MADE BY SHREVE & Co

Events, Trophies and Winners.

EVENT.		TROPHY.	WINNER.
Trap Shooting	1.	Tankard	A. E. Drendell.
Approaching and Putting Contest	2.	Cup. Donated by Shreve & Co.	E. M. Demming.
Runner-Up Jobbers' First Flight	3.	Cup	C. C. Sibley.
Manufacturers' Qualifying Round	4	Goblet. Donated by Hotel Del Monte.	R J. Davis.
Best Score Jobbers' Qualifying Round	5.	Goblet. Donated by Hotel Del Monte.	R D. Holabird.
First Men's Tennis Tournament	6.	Military Brushes	H. I. Sackett.
Runner-Up Manufacturers' First Flight	7.	Cup	T E. Bibbins.
Winner Manufacturers' First Flight	8.	Goblet	W. J. Grady.
Winner Jobbers' Third Flight	9.	Cup	Chas. White. (H.V. Carter, tied)
Winner Jobbers' Second Flight	10.	Goblet. Donated by T. E. Bibbins	C. P. Hill.
Women's Putting Contest	11.	Cologne Bottle. Donated by T. E. Bibbins.	Mrs. E. W. Rockafellow.
Men's Approaching and Putting Contest	12.	Flask. Donated by T. E. Bibbins	E. M. Demming.
First Women's Tennis Tournament	13.	Candy Jar	Miss K. Carter.
Winner Manufacturers' Third Flight	14.	Goblet	E. K. Patton
Second Men's Tennis Tournament	15.	Silver Deposit Bottle	G. R. Jones.
Winner Jobbers' First Flight	16.	Cup. Donated by T. E. Bibbins	Fred Fullerton.
Second Women's Tennis Tournament	17.	Bridge Whist Set	Mrs. H. G. Aylsworth.
First Pool Tournament	18.	Cup	W. T. McCullough.
Second Pool Tournament	19.	Silver Deposit Bottle	W. S. Berry.
Winner Manufacturers' Second Flight	20.	Cup	B. M. Downs.
Men's Driving Contest	21.	Tankard. Donated by Andrew Carrigan	H. E. Sanderson

itself caused him to cry himself to sleep. The ladies thought it was rain. Spike tails were pressed and ball gowns donned for a night of dancing.

Thursday opened bright with the sun staring them in the face, as much as to say, "Do your worst, I'm here for the day." With sunshine added to the radiance of the beautiful women and the glorious scene, it was like a transformation. All talk of the west coast of Florida, the salubrious climate of Spain and Italy ceased, Del Monte had added to her million and more admirers, the electrical jobbers, the manufacturers, and their ladies of the United States. The finals in the several contests of tennis, golf and pool were finished, the ladies putting contest, the whist, 500, keeno, and old maid gambling games were decided.

Trap-Shooting.

As the notice on the bulletin board read "Dress for the Spanish dinner as you please, but come," everyone was soon ready for the bursting of the bomb. This Spanish dinner was held in the opera house of old Monterey. Again the wonderful ability of Boniface Warner as an entertainer and host was exemplified.

Ladies' Putting Contest.

Places had been set for 250 (you will note each event, the number has been increased, at this time nearly all the guests of Del Monte had joined the jobbers' party). Arrangements were so perfect that it took but a short time for everyone to find their proper place.

The toastmaster requested the guests to be seated, this was followed by a bombardment of serpentine from the "gringos," some dozen or fifteen of the bright lights of the East and West, who donned the Spanish costume. In one short minute where all had been clear overhead, was now a perfect maze of spider webs in all colors of the rainbow. Thousands of strands of this colored paper festooned and draped in the most fantastic shapes, only as accident could design, no art could have formed a more beautiful picture. This was allowed to remain but a few moments as things and things and things were to happen. Each guest literally tore himself loose and soon the floor was carpeted with paper.

The menu was a simple Mexican dish known as a a "hot tamale," a dish of enchiladas and Mexican "Hades" stew; following this was an ice cream to cool off. During the dinner the following musical program was given:

Selection ....Spanish Orchestra
Feliciano Graxiola, Director.

El Chirrion (The Whip Dance)...........Senorita Dulce Osio

La Cacucha (Dance)................Senorita Jobinita Graxiola

La Paloma (Song).......................Senorita Frances Diaz

La Esmeralda de Portola (Dance) ...... Chiquita Beatrice Osio

A Gypsy Maiden (Solo) ....*Parker*
Miss Pickering.

El Jarabe (Mexican Jig)...................................
..............Senor Roman Valencia y Senora Juanita Clay

La Contradanza (Mexican Figure Dance)..................

Senoras: Marta Cooper, Margarita Estrada, Ray Baubian, Julia Trenner, Dulcie Osio, Maria Baddres.

Senores F. Graxiola, Vicente Estrada, Esteben Davis, L. Trenner, Jose Madriaga, Y. A. Dutra.

La Barsobiana ....By the Company

After the dinner the tables were cleared from the room and the debonnaire Andrew Carrigan, from the stage, announced the winners and distributed the prizes in a novel and enjoyable way, calling upon some member of the audience to deliver the presentation speech. Not one word of the speeches will we attempt to chronicle, or we would have to give them all. Before half of the prizes had been distributed it became a case of grab-bag, as those who did not win prizes were impatient for the dances. A quarter of a serpentine football match was played, then dancing and jollity ad libitum.

Among those who did not stay away were P. J. Aaron, Western Electric Co., Seattle, Wash.; R. Ackerman, Western Electric Co., Salt Lake City, Utah; Mr. and Mrs. W. L. Adams, Union Hardware & Electric Supply Co., Providence, R. I.; Harry Adams, R. B. Corey & Co., New York, N. Y.; D. E. Albert, Los Angeles, Cal.; Mr. and Mrs. F. T. Andrea, Julian Andrea & Sons Co., Milwaukee, Wis.; F. N. Averill, Fobes Supply Co., Portland, Ore.; W. B. Ayer, Belcher-Loomis Hardware Co., Providence, R. I.; Mr. and Mrs. H. G. Aylsworth, Aylsworth Agencies Co., San Francisco, Cal.;

F. C. Barrington, Columbian Electric Co., St. Joseph, Mo.; F. M. Bernardin, The B-R Electric & Tel. Mfg. Co., Kansas City, Mo.; Mr. and Mrs. W. S. Berry, Western Electric Co., San Francisco, Cal.; H. D. Betts, Thomas & Betts, New York, N. Y.; T. E. Bibbins, General Electric Co., San Francisco, Cal.; Julian Binford, Jr., Tower-Binford Electric & Mfg. Co., Richmond, Va.; H. W. Bliven, Harvey Hubbell Co., Bridgeport, Conn.; Mr. and Mrs. F. N. Boyer, General Electric Co., Chicago, Ill.; Mr. and Mrs. W. W. Briggs, Westinghouse Electric & Mfg. Co., San Francisco, Cal.; Mr. and Mrs. John W. Brooks, Pass & Seymour Co., Syracuse, N. Y.; Mr. and Mrs. Chas. E. Browne, American Electrical Supply Co., Chicago, Ill.; W. A. Browne, M. B. Austin & Co., Chicago, Ill.; T. E. Burger, Western Electric Co., Los Angeles, Cal.;

Mr. and Mrs. Andrew Carrigan and daughter, Dunham, Carrigan & Hayden Co., San Francisco, Cal.; H. V. Carter and daughter, Pacific States Electric Co., San Francisco, Cal.; C. H. Carter, Pacific States Electric Co., Los Angeles, Cal.; Mr. and Mrs. J. O. Case, General Electric Co., Los Angeles, Cal.; B. C. Chase, Los Angeles, Cal.; James Clark, Jr., James Clark, Jr.

Ladies at Pebble Beach Lodge.

Electric Co., Louisville, Ky.; R. F. Cleavenge, Pittsburg, Pa.; Mr. and Mrs. Geo. A. Cole, John R. Cole Co., Los Angeles; Mr. and Mrs. John R. Cole, John R. Cole Co., San Francisco, Cal.; Mr. and Mrs. John J. Cooper, Mountain Electric Co., Denver, Colo.; Mr. and Mrs. C. E. Corrigan, National Metal Moulding Co., Pittsburg, Pa.; Mr. and Mrs. N. C. Cotabish and daughter, National Carbon Co., Cleveland, Ohio.; J. Robert Crouse, Cleveland, Ohio; Mr. and Mrs. H. H. Cudmore, Brilliant Electric Co., Cleveland, Ohio;

Mr. and Mrs. A. D. Dana, Chicago Fuse Mfg. Co., New York, N. Y.; Mr. and Mrs. J. C. Davidson, Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; C. C. Davis, General Electric Co., San Francisco, Cal.; R. J. Davis, Century Electric Co., San Francisco, Cal.; Judge T. M. Debevoise, New York City.; C. R. Dederick, C. R. Dederick Electric Supply Co., Portland, Ore.; W. M. Deming, General Electric Co., Schenectady, N. Y.; V. R. Despard, Pass & Seymour, Syracuse, N. Y.; Mr. and Mrs. D. D. Dickey, National Carbon Co., Cleveland, Ohio; R. J. Dinwiddie, Salt Lake City, Utah; B. M. Downs, Brookfield Glass Co., New York, N. Y.; Mr. and Mrs. T. W. Dunk, Florida Electric Co., Jacksonville, Fla.; A. E. Drendell, Drendell Electric & Mfg. Co., San Francisco, Cal.; E. J. Dwyer, Holabird Electric Co., Seattle, Wash.:

J. S. Eells, Pacific States Electric Co., San Francisco, Cal.; F. W. Eastman, Stanley & Patterson Co., New York, N. Y.; Mr. and Mrs. Albert H. Elliott and daughter, San Francisco, Cal.

Mr. and Mrs. P. M. Fletcher, Fletcher-Stanley Co., New York, N. Y.; E. N. Fobes, Fobes Supply Co., Seattle, Wash.; Frank Fowden, Brooks-Follis Co., San Francisco, Cal.; H. F. Frosch, Federal Electric Co., San Francisco, Cal.; Mr. and Mrs. F. W. L. Fullerton, Fullerton Electric Co., New York, N. Y.:

A. C. Garrison, Columbia Incandescent Lamp Co., St. Louis, Mo.; L. V. Garron, Frank H. Stewart Electric Co., Philadelphia, Pa.; Mr. and Mrs. V. F. Gates, National Metal Moulding Co., Pittsburg, Pa.; Mr. and Mrs. J. F. Gilchrist and children, Chicago, Ill.; S. W. Gilman, San Francisco, Cal.; F. B. Gleason, Western Electric Co., San Francisco, Cal.; Mr. and Mrs. W. L. Goodwin, Pacific States Electric Co., San Francisco, Cal.; Mr. and Mrs. W. J. Grady, Faries Mfg. Co., Decatur, Ill.; Mr. and Mrs. E. C. Graham, National Electric Supply Co., Washington, D. C.; N. W. Graham, Holabird, Reynolds Co., Los Angeles, Cal.; Mr. T. H. Green, Wheeler-Green Electric Co., Rochester, N. Y.; Mr. and Mrs. S. B. Gregory, Arrow Electric Co., San Francisco, Cal.; Mr. and Mrs. L. Griesser, Cleveland Electric Supply Co., Cleveland, Ohio.

H. S. Hadley, Harvey Hubbell Co., Bridgeport, Conn.; C. W. Hahn, San Francisco, Cal.; C. B. Hall, Pasadena, Cal.; A. H. Halloran, Journal of Electricity, Power & Gas, San Francisco, Cal.; Mr. and Mrs. C. M. Hamilton, F. Bissell Co., Cleveland, Ohio; E. D. Hand, Decker Electric Co., San Francisco, Cal.; Mr. and Mrs. F. S. Hardy, Frank S. Hardy & Co., Boston, Mass.; Ross Hartley, Pacific States Electric Co., Portland, Ore.; Mr. and Mrs. N. G. Harvey and daughter, Illinois Electric Co., Chicago, Ill.; C. B. Hawley, Salt Lake City, Utah; D. C. Hemingray, Hemingray Glass Co., Covington, Ky.; Mr. and Mrs. J. A. Herr, Sprague Electric Co., San Francisco, Cal.; Mr. and Mrs. W. R. Herstein, Electric Supply Co., Memphis, Tenn.; Mr. and Mrs. C. P. Hill, Double-Day Hill Electric Co., Pittsburg, Pa.; Mr. and Mrs. C. C. Hillis, Electric Appliance Co., San Francisco, Cal.; Chas. I. Hills, Franklin Incandescent Lamp Co., New York, N. Y.; J. L. Hinds, Crouse, Hinds Co., Syracuse, N. Y.; R. D. Holabird, Holabird, Reynolds Co., San Francisco, Cal.; H. H. Hornsby, Sprague Electric Co.; New York, N. Y.; Mr. and Mrs. J. H. Hughes, New York, N. Y.; Chas. Hudson, Los Angeles, Cal.:

Spencer Isely, Milwaukee, Wis.:

G. R. Jones, North Shore Electric Co., Chicago, Ill.; Paul Joyslin, Western Electric Co., Dallas, Tex.:

Geo. E. Kellogg, Central Electrical Supply Co., New York, N. Y.; Mr. and Mrs. R. C. Kemp and daughter, Montana Electric Co., Butte, Mont.; G. I. Kinney, Fort Wayne Electric Co., San Francisco, Cal.; L. W. Kittman, Chicago, Ill.; Mr. and Mrs. P. S. Klees, Franklin Electrical Mfg. Co., Hartford, Conn.; B. F. Klein Brass Fixture Co., Cleveland, Ohio; L. W. Korsemeyer, Korsemeyer Co., Lincoln, Neb.; Robert Kuhn, American Electric Heater Co., Detroit, Mich.; Mr. and Mrs. E. J. Kulas, Tungstolier Co., Cleveland, Ohio;

L. A. Landan, New York City, N. Y.; H. M. Lauritzen, Holophane Co., San Francisco, Cal.; C. W. Leveridge, New York, N. Y.; A. W. Lindgren, Minneapolis Electrical Engineering Co., Minneapolis, Minn.; Mr. and Mrs. C. J. Litscher, C. J. Litscher Electric Co., Grand Rapids, Mich.; F. W. Loomis, Holophane Co., San Francisco, Cal.; M. E. Logan, San Francisco, Cal.;

Mr. and Mrs. W. W. Low, Electric Appliance Co., Chicago, Ill.;

Mr. and Mrs. W. T. McCullough, McCullough Elec. Co., Pittsburg, Pa.; J. W. McDowell, Manhattan Electrical Supply Co., New York, N. Y.; Mr. and Mrs. M. McGraw, Interstate Elec. & Mfg. Co., Sioux City, Iowa; H. F. McGregor, Providence, R. I.; D. S. McGonigle, B-R Elec. & Tel. Co., Kansas City, Mo.; Mr. and Mrs. C. T. McKinstry, The Erner Elec. Co., Cleveland, Ohio; J. R. McNaughton, McNaughton-McRay Elec. Co., Detroit, Mich.; A. P. Manning, Cutler-Hammer Mfg. Co., New York, N. Y.; Mr. and Mrs. W. W. Merrill, Chicago Fuse Mfg. Co., Chicago, Ill.; L. H. Mertz, Pacific Electric Heating Co., Ontario, Cal.; A. G. Monroe, Nebraska Electric Co., Omaha, Neb.; Mr. and Mrs. R. C. Murdock, Iron City Elec. Co., Pittsburg, Pa.; F. H. Murray, Los Angeles, Cal.; F. S. Mills, H. W. Johns-Manville Co., Los Angeles;

Mr. and Mrs. R. F. Oakes, American Ever Ready Co., San Francisco, Cal.; L. J. O'Brien, New England Elec. Supply Co., Hartford, Conn.; W. I. Otis, Otis & Squires Co., San Francisco, Cal.; Franklin Overbaugh, General Secretary National Electrical Jobbers' Association, Chicago, Ill.;

Mr. and Mrs. A. D. Page and daughter, General Electric Co., Harrison, N. J.; A. H. Patterson, Phoenix Glass Co., New York, N. Y.; Mr. and Mrs. G. L. Patterson, Stanley & Patterson, New York, N. Y.; F. G. Patterson, New York, N. Y.; A. N. Palmer, Phillips Insulated Wire Co., Pawtucket, R. I.; E. K. Patton, Bryant Electric Co., Chicago, Ill.; R. L. Phelps, Safety Insulated Wire & Cable Co., San Francisco, Cal.; Mr. and Mrs. J. G. Pomeroy, Adams-Bagnall Co., Chicago, Ill.; F. H. Poss, Holophane Co., San Francisco, Cal.; Mr. and Mrs. F. S. Price, Pettingell-Andrews Co., Boston, Mass.; J. P. Provost, Union Electric Co., Pittsburg, Pa.;

Mr. and Mrs. T. C. Ringgold, Central Electric Co., Chicago, Ill.; Mr. and Mrs. E. W. Rockafellow, Western Electric Co., New York, N. Y.; R. L. Robertson, San Jose, Cal.; Mr. and Mrs. P. H. Rutter, Newark Elec. Supply Co., Newark, N. J.; J. F. Ryan, Portland, Ore.; S. P. Russell, H. W. Johns-Manville Co., San Francisco;

H. I. Sackett, Buffalo, N. Y.; Mr. and Mrs. S. H. Sands, Elec. & Mfg. Co., Wheeling, West Virginia; H. E. Sanderson, Bryant Electric Co., San Francisco, Cal.; R. F. Sanford, San Francisco, Cal.; Mr. and Mrs. E. M. Scribner and children, Arrow Electric Co., Chicago, Ill.; R. H. Scranton, American Elec. Heating Co., Detroit, Mich.; Mr. and Mrs. E. L. Scott, Kansas City Elec. & Tel. Supply Co., Kansas City, Mo.; Mr. and Mrs. L. A. Schwab, Monarch Elec. & Wire Co., Chicago, Ill.; Mr. and Mrs. H. B. Scott, Syracuse Elec. Co., Syracuse, N. Y.; Mr. and Mrs. W. H. Seaver, American Steel & Wire Co., San Francisco, Cal.; A. A. Serva, Fort Wayne Electric Co., Fort Wayne, Ind.; I. A. Shorno, Portland, Ore.; W. H. Seldon, Miller-Seldon Elec. Co., Detroit, Mich.; Mr. and Mrs. C. C. Sibley, Sibley & Pitman, New York, N. Y.; F. F. Skeel, Crouse-Hinds Co., Syracuse, N. Y.; Mr. and Mrs. G. I. Smith and children, J. F. Buchanan, Elec. Supply Co., Philadelphia, Pa.; M. F. Steel, Benjamin Electric Mfg. Co., San Francisco, Cal.; Mr. and Mrs. F. H. Stewart, F. H. Stewart Elec. Co., Philadelphia, Pa.; Mr. and Mrs. F. E. Stow, H. C. Roberts Elec. Supply Co., Philadelphia, Pa.; Mrs. W. E. Strater, Louisville, Ky.; Mr. and Mrs. E. B. Strong, Journal of Electricity, Power & Gas, San Francisco, Cal.; J. D. Sweeney, Royal-Eastern Elec. Supply Co., New York, N. Y.; Mr. and Mrs. J. E. Swisher, Globe Elec. Co., Dayton, Ohio;

Mr. and Mrs. Samuel H. Taylor, Elec. & Mfg. Co., San Francisco, Cal.; F. S. Terry, National Lamp Association, Cleveland, Ohio; Mr. and Mrs. J. B. Terry, J. G. Terry Co., Cedar Rapids, Iowa; W. J. Toncin, Ansonia Elec. Co., Ansonia, Conn.; Mr. and Mrs. O. C. Turner, Southern Wesco Supply Co., Birmingham, Ala.;

J. A. Vandegrift, National Electric Lamp Association, San Francisco, Cal.; H. F. Van Riper, Seattle, Wash.; H. B. Vanzwoll, Sunbeam Incandescent Lamp Co., Chicago, Ill.; W. H. Vanzwoll, Chicago, Ill.;

Mrs. Annie Warner, Philadelphia, Pa.; T. G. Whaling, Westinghouse Lamp Co.; Bloomfield, N. J.; Mr. and Mrs. Chas. F. White, Geo. H. Buckminster, Co., Boston, Mass.; C. E. Wiggin, Dunham, Carrigan & Hayden Co., San Francisco, Cal.; H. S. Wilson, F. H. Stewart Elec. Co., Philadelphia, Pa.; A. E. Williams, Colonial Elec. Co., Warren, Ohio; H. B. Woodill, Woodill-Hulse Co., Los Angeles, Cal.; F. H. Woodward, Ruud Automatic Gas Heater Co., San Francisco, Cal.;

Garnet Young, Tel. & Elec. Equipment Co., San Francisco, Cal.

LAMP ASSOCIATION DISSOLVES.

The Association of Licensed Manufacturers of Incandescent Lamps has dissolved. This association manufactures lamps under patents of the General Electric Company, which as licensor, it is alleged, has heretofore fixed the prices, terms and conditions under which lamps covered by patents owned by it are manufactured and sold. These manufacturers will continue as licensees of the General Electric Company, but the formal association is discontinued. The companies involved in the dissolution are as follows: General Electric Company, Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company, National Electric Lamp Company, Aetna Electric Company, American Incandescent Lamp Company, Banner Electric Company, Brilliant Electric Company, Bryan-Marsh Company, Buckeye Electric Company, Capital Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, Economy Electric Company, Franklin Electric Manufacturing Company, General Incandescent Lamp Company, Independent Incandescent Lamp Company, Kentucky Electric Company, Liberty Electric Manufacturing Company, Munder Electric Company, Standard Electric Manufacturing Company, Sterling Electric Manufacturing Company, Sunbeam Incandescent Lamp Company, Warren Electric Specialty Company, Gilmore Electric Company, Fostoria Incandescent Lamp Company, New York & Ohio Company and Shelby Electric Company.

PACIFIC COAST A. I. E.E. CONVENTION.

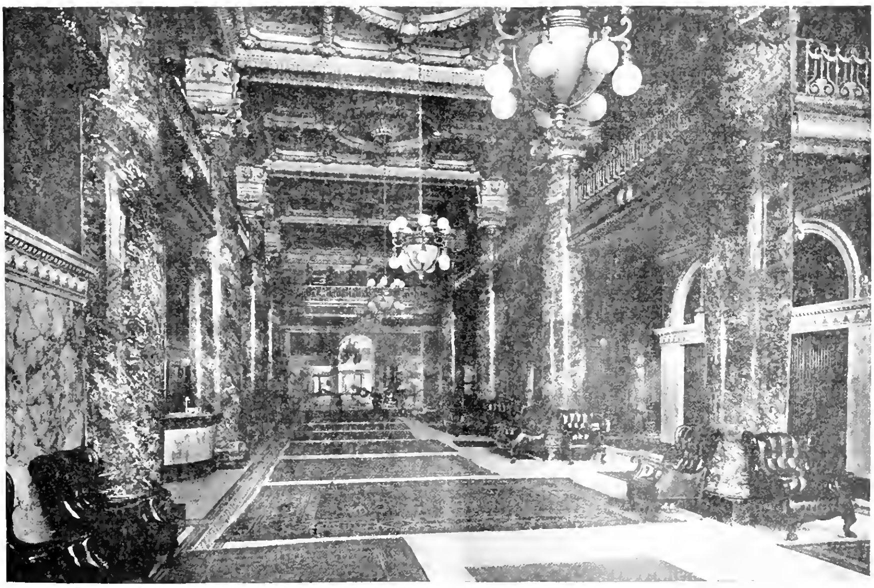
The Los Angeles convention of the American Institute of Electrical Engineers opened on Tuesday, April 25th, at the Hotel Alexandria, with a large initial attendance. The first meeting was called to order at 11 o'clock by the chairman of the Los Angeles Section, Mr. J. E. MacDonald. In a few words he introduced Mayor George Alexander, who gave a short, but appropriate speech welcoming the delegation to Los Angeles. In part he said: "We have come to realize electricity as one of the greatest inventions of man and even now we look towards its use to accomplish many things which must be done for us. In a short time we may expect its use in the home, to displace all drudgery; we will cook, wash and run our sewing machines with it. I can remember, forty years ago, when our only electrical men were the telegraph operators and even but few of these could work by sound only, but required the tape and recording instruments. Our city can develop 120,000 h.p. in electrical energy from its water-power and there are many more opportunities outside of this. This is to be used in the homes and we have the best country in the world for homes."

Ralph W. Pope.

Ralph D. Mershon.

The chairman, with a short introduction, appointed Mr. Ralph D. Mershon as temporary chairman.

The first paper read was that of Mr. O. D. Ensign and Jas. M. Gaylord, on "Transmission Applied to Irrigation." Mr. Ensign did not read the paper, which



Lobby Hotel Alexandria, Los Angeles.

is devoted to a description of the Minidoka irrigation and power project in Idaho and the Salt River project, in Arizona, both built by the United States Reclamation Service, of which Messrs. Ensign and Gaylord are engineers. Those papers are valuable, in that they not only describe the systems but gives much valuable data on costs.

Regarding irrigation, Mr. Ensign stated that the actual cost of irrigating 50,000 acres was $1.50 per acre per annum, and the construction charge about $40 per acre, including the proportionate cost of power canals and controlling works at the laterals.

Mr. Ensign spoke briefly on a number of government projects not described in the paper. In the development of irrigation works natural power sites are often created by diversion works. The law is so broad that it allows the Reclamation Service to develop available power and utilize it for pumping.

The new runners in the turbine at the Roosevelt Dam power-house have increased the unit capacity from 6500, as reported, to 7500 kw., as corrected.

Discussion on Transmission Papers.

The paper by Mr. R. J. C. Wood on "Transmission Systems, from an Operating Standpoint," was next read by the author. The discussion on both transmission papers was opened by Mr. A. H. Babcock, who asked a number of questions as to more definite data on the proper use of capacity formulas in line calculation, also as to the probability of more than one wire of a line breaking at one time. He said that there had been criticism of the high tension conductors in the Fruitvale power house of the Southern Pacific Company, and thought that future changes would justify this action.

C. L. Cory commented on the fact that a less permanent form of construction than that described by Messrs. Ensign and Gaylord was often permissible in private irrigation plants whose load had not yet been developed. He also raised the question as to what is to be done with the power from these plants during that part of the year when pumping is not necessary.

E. F. Scattergood remarked that information on bad features of operation was even more interesting than the good features. He also asked if there was anything that could prevent the Government from selling its surplus power.

Paul M. Downing corroborated Mr. Wood's unsatisfactory estimate of automatic regulators for voltage at the power house end. His experience shows that intelligent hand operation is more efficient. Mr. Downing disagreed with Mr. Wood's stricture of synchronous regulating apparatus on account of its first cost and advocated the use of synchronous condensers on lines carrying induction motors. He emphasized the seriousness of leakage as compared with the infrequency of lightning on the Pacific Coast.

Mr. Jas. A. Lighthipe spoke of the unexpected growth of loads for developed power and commented on the great increase in transmission voltages in recent years.

Ralph Bennet spoke of the use of 100,000 volts by the Great Western Power Company and of the advantages of tower support with suspension insulators over the old wooden poles and arms.

C. W. Koiner spoke of the value of the cost data in the paper on "Transmission as Applied to Irrigation," and its reasonableness as compared with the cost of rehabilitating Eastern farms and Southern plantations.

L. J. Corbett presented some interesting data on conditions in the Northwest, especially around Spokane. He stated that 100 days is the usual length of the irrigation season in that vicinity.

Ralph D. Mershon, the chairman, warned against the use of a high voltage except where it is economically justified and emphasized its folly on lines which distribute more power to small consumers than is transmitted to more distant ones. He spoke of the success obtained with the horn type of lightning arresters and graded gaps in the East. He also described Mr. L. C. Nicholson's method of removing a short circuit from the line by short-circuiting the generating station and then removing it in less than five cycles. This is automatically done by flap switches or leaf steel springs bent back to a tension of thirty pounds and released by triggers in case of a short. After the switch is sprung an expulsion fuse breaks the short circuit thus created. He questioned the depth from which water can be profitably pumped and spoke of the danger of a pump robbing neighboring ground. This latter point was more extensively discussed by Mr. Lighthipe.

In closing the discussion Mr. Ensign emphasized the necessity for concrete construction. He stated that the economic depth of pumping depended upon the crop to be irrigated, being profitably conducted at 200 ft. for oranges and only 30 ft. for alfalfa. As the power is usually developed by the water being used for irrigation there is seldom any power developed in the seasons of no irrigation. Where surplus power is generated, as at the Minidoka project, it is sold at a low rate to encourage the development of the surrounding territory. Mr. Ensign also gave an exhaustive summary of the irrigation law and its workings.

Mr. R. J. C. Wood, in closing the discussion on his paper, stated that the approximate formula for calculating transmission lines was applicable up to 150 mile lines, beyond which the accurate formula should be used as a correction. Experience shows that more than one wire seldom breaks before the power can be switched off. He suggested an amperage rating for switches as being preferable to a kilowatt basis. Adjournment was then taken.

Electric Furnaces.

At the afternoon session, after some introductory remarks by Secretary Pope, C. F. Elwell's paper on "The Refining of Iron and Steel by Induction Type Furnaces," in the absence of the author, was read by C. W. Koiner. Brief discussions were given by R. W. Van Norden, E. W. Paul, J. J. Frank, H. H. Sinclair, R. W. Sorenson, C. W. Koiner and Budd Frankfield, consisting most of queries which were not satisfactorily answered in the absence of the author.

Ciscoidal Oscillations.

Under the temporary chairmanship of K. B. Miller, Mr. Campbell's paper on "Ciscoidal Oscillations" was read by title.

C. L. Cory gave an able and comprehensive explanation of the theory of ciscoidal oscillations in

simplified language. Temporary Chairman K. B. Miller believes that this paper is a classic and will be of great value in future telephone developments. It is like much of Maxwell's work in that it is ahead of its time.

Redondo Trip.

On Tuesday afternoon adjournment was taken at 4:30 o'clock and a half hour later the members boarded a special train of the Los Angeles-Pacific Railway, the objective point being Redondo Beach where dinner was to be served and a visit made to the modern generating plant of the Pacific Light & Power Company. A round-about route was chosen, passing through the beautiful residence suburb of Hollywood, the Soldiers' Home, Santa Monica, Ocean Park, Venice, and the string of gay beach towns between those points and Redondo.

Upon arrival at Redondo, the party of about 120 spent nearly an hour in examining the power plant. This plant has a generating capacity of about 30,000 kw. and is interesting in that it illustrates the sweeping progress that has been made in changing from reciprocating engines to turbines. Built two years ago, this plant was equipped with 3 four-cylinder, cross compound Corliss engines driving 5000 kw. 3-phase 18,000 volt generators. This plant when installed was said to represent the very highest progress in reciprocating engine design and the test efficiencies reported were uncommonly high. During the last year, the plant has been overhauled and enlarged and two 12,000 kw. Curtis turbine driven vertical sets have been installed. Each one of these machines is capable of delivering as much power as the combined output of the three older sets and both together occupy only about as much space vertically and horizontally as one of the older sets. Much interest was manifested in the intake for condenser water from the ocean and the new pumping plant installed in connection therewith.

By the time the crowd were again gathered together it did not require much persuasion on the part of the party leaders to get them to the pavilion on the beach where a good dinner was ready. All were seated by eight o'clock and the well served meal was greatly enjoyed with the accompaniment of much fun and joshing.

Mr. McDonald acted as toastmaster and called on a number of those present to respond. Among those who spoke were Messrs Lighthipe, Babcock, Pope, Mershon, Cory and Foster. The speeches, while full of fun and wit of the scintillating variety, such as is inspirited by the various "juices" with which electrical engineers are most familiar, were also more or less dignified and instructive. At eleven o'clock the party boarded the "special" for the return trip to Los Angeles.

Telephone Papers.

The second day's session was called to order at 10:00 a. m. by the temporary chairman, Mr. K. B. Miller. The paper by Mr. Chas. S. Winston on "New Automatic Telephone Equipment, was presented by the author. This paper is a technical description of a modern automatic system.

Chairman Miller remarked that this paper is a frank discussion of apparatus not yet in general use and work regarding which the developers generally wish to keep silent. The paper is directed more to the semi-automatic system. Mr. Edward D. Clement was then introduced.

The paper by Mr. Clement on "The Semi-Automatic Method of Handling Telephonic traffic," was then read.

The sole purpose of developing the auto-manual systems is to develop economies. Telephone development having been very wasteful; does away with branch exchanges, bringing all operations to one point.

The paper was read, very full interpretations were given in going into more detail to explain apparatus and amplify the reasons for all devices used.

The system is absolutely secret, as the operator after calling the party is automatically disconnected from the subscribers and has no further control over them. Adjournment for lunch was then taken.

The afternoon session was called to order by Mr. Miller, temporary chairman of the telephone committee.

The paper by Mr. Brown on "Some Recent Developments in Railway Telephony," was given by the author. This was deemed advisable before discussing the two previous telephone papers. Mr. Brown abstracted his paper, explaining details to some length.

Chairman K. B. Miller, in introducing the discussion on the telephone papers, divided it into two sections, the automatic and the automanual systems, and the railway telephone paper.

J. W. Gilkyson, as the Los Angeles manager of the manual system, did not wish to malign the automatic method, but believes that the semi-automatic will be the neutral factor in ultimately bringing the other two together.

Leo Keller, chief engineer of the Los Angeles Home Telephone Company, quoted from a letter from a German correspondent, in which he describes the installation of a half-automatic exchange in Amsterdam with the view of ultimately making it full automatic. His view of the local situation is that the semi-automatic is but a step toward the full automatic.

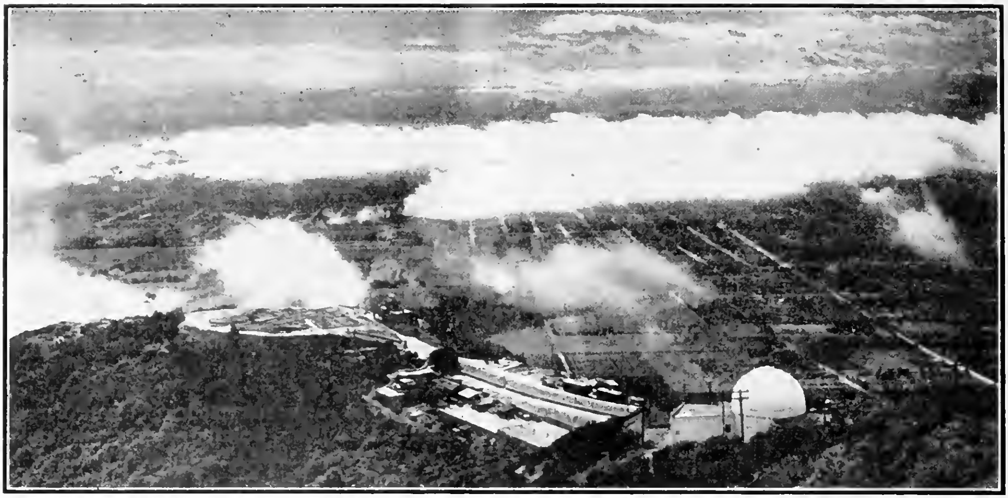
A. H. Griswold stated the main object of a telephone company was to provide service that is reliable, efficient and popular. The question of providing the best type of equipment at the least ultimate cost is secondary to giving the public what they want. He asked information as to how calls could be reverted in the automanual system and as to how simultaneous connections were provided for.

H. A. Foster spoke of the advantages of the manual system and the liability for mistakes with the automatic.

A. H. Babcock, speaking as a subscriber, and not as an engineer, spoke of the central as the weak link in the chain of the manual system, because of the mistakes that she is continually making.

R. W. Pope commented on the satisfactory operation of private branch exchanges in the New York manual system.

J. W. Gilkyson called attention to the fact that in the manual system all mistakes are charged to the operator and that like mistakes on the part of the



View of Echo Mountain and Pasadena from Mt. Lowe Above the Clouds.

subscriber are overlooked. An abrupt man is likely to get poorer service than one who is courteous.

Mr. Newell spoke of the advantages of the automatic with a foreign population. Leo. Keller corroborated his views.

W. D. Moore described the operation of the observation board that automatically shows when the subscriber takes the receiver, when the operator plugs in to answer, the moment she rings, the moment the subscriber takes the receiver to answer, the moment he hangs up and the moment the disconnection is made. This shows, among other things, that but 0.1 per cent of the entire number of connections completed were rung in error. Mr. Moore thinks that the automatic will be the stepping stone to the semi-automatic in the larger cities where busy men do not care to manipulate the instruments themselves. Smaller cities can be well served by the automatic.

Mr. Schuler of Santa Barbara spoke of the better service given by the semi-automatic because, as shown by a personal canvas, a large percentage of subscribers preferred to give the number to the operator.

Mt. Lowe Trip.

H. B. Tupper explained the use of automatic stick-down keys in the manual system, whereby the subscriber can easily notify the operator of failure in making a connection.

The second day session terminated at 4:00 p. m. as the second outing which had been planned for the members of the convention and their ladies followed. The party numbering about 150 gathered at the depot of the Pacific Electric Railway, and at 5:00 o'clock boarded special cars to be taken to the Alpine Tavern on Mt. Lowe.

This trip took the party through the cities of Pasadena and Altadena, and aside from showing many beautiful homes and lovely landscapes, gave the engineers an opportunity to observe what is perhaps the finest piece of interurban railroad in the world.

The cars were left at Rubio canyon, one of the many rugged gulches of the San Gabriel range, and at an elevation above sea level of about 2300 ft. Here transfer was made to the famous incline road which follows the precipitous slope of Echo Mountain to its summit where is situated the Lowe observatory. This incline is operated by a 1¼ in. steel cable, there being two cars, fastened to either end of the cable, the one ascending as the other descends. The total length of this incline is 3000 ft. and the vertical rise, 1700 ft., and the grade at the steepest part is 63 per cent.

From Echo Mountain to the Alpine Tavern, the line is nominally an ordinary trolley road, having a gauge of 36 in. A ride over this road however will convince the engineer that there is nothing ordinary about it as the many difficult engineering problems are thoroughly impressed upon those who may be fortunate enough to take the trip.

The Alpine Tavern is at an altitude of over 5000 ft. and the members of the party found the huge fireplace and hospitable welcome much to their liking. Dinner was ready for the hungry party, and all agreed that no mistake had been made in coming to this famous resort. There was no attempt at speechmaking as the time for return was limited, therefore, after a big dinner, the cars were again entered and the descent begun.

Upon arriving again at Echo Mountain, the night panorama of the San Gabriel valley was spread out far below. In the foreground, but far below, the myriad lights of Pasadena sparkled and glistened like an inverted firmament, much farther the lights of Los Angeles could be seen, and still farther at distances of fifty miles or more, the glow of lights from the many beaches on the Pacific Ocean could be distinguished.

The party arrived in Los Angeles, late in the evening, tired but happy.

Telephone Discussion.

The telephone discussion was concluded on Thursday morning with K. B. Miller acting as chairman. He spoke of the importance of railway dispatching by means of the telephone and suggested the advisability of a separate circuit for operating the selective

bells on the dispatching system instead of loading on already overloaded circuit with selective ringing apparatus as well as a multiplicity of talking circuits.

L. B. Cramer questioned whether time is saved by the arrangement permitting the signalling to be interrupted for conversation. He recommended larger calling bells and even an auxiliary bell for this purpose. He spoke of the tendency to plug the talking button. He also compared two makes of retardation coils, and spoke of the efforts of telegraph operators to hamper telephone dispatching.

Ralph Bennett asked whether selective apparatus could be designed to work in the presence of high voltage transmission lines.

R. W. Pope recalled early experiences with the telegraph and its advantages in receiving by sound without the necessity of holding a receiver to the ear.

K. B. Miller also spoke of the dispatcher's objection to wearing a harness, and of the failure of loud-speaking telephones.

C. F. Elwell told of the successful use of telephones for train dispatching in Australia ten years ago by means of code ringing.

S. G. McMeen showed that a well-balanced telephone line is not affected by external transmission lines.

J. A. Lighthipe traced the early difficulties in the manufacture and use of telephone equipment, contributing some interesting personal experiences.

S. J. Lisberger described an automatic dispatching telephone system for electric sub-stations in use in San Francisco.

Chas. S. Winston, in closing the discussion on "New Automatic Telephone Equipment," stated that no satisfactory means of reverting calls on a two-wire automatic system has yet been devised, but that little trouble has been experienced because of their infrequency. The chance of two subscribers plugging in on the same line simultaneously is small and this is not likely to cause trouble. He also spoke of the difficulty of handling measured service with automatic equipment. While service is important it is subsidiary to cost of installation.

Edward C. Clement spoke of the pioneer work of Americans in the telephone field. He stated that the automanual was an attempt to give the subscribers the individual attention of an operator at a minimum cost to the company. This system relieves the operator from much strain and reduces the number of complaints. Measured service is possible by means of the telechrometer, which is based upon a logical plan to show the total time and distance talked during a month.

Gregory Brown did not think it necessary to have a separate signalling wire as the high impedance of selectors do not materially load the line. Various simple arrangements allow ringing till answer is given. A satisfactory loud-speaking instrument will undoubtedly soon be developed. Repeating and writing all dispatching orders is sufficient safeguard against accidents.

S. G. McMeen expressed the thanks of the telegraphy and telephony committee for the prompt work, forbearance, patience and attendance of the authors of the telephone papers. Chairman A. E. McDonald expressed the thanks of the Institute for Mr. McMeen's hard work in getting together the material for the meeting.

Continuity of Service in Transmission Systems.

R. J. C. Wood suggested that instead of opening a short circuit, with its attendant danger of burning the line in two, that it is better practice to lower the voltage and thus clear the short circuit. Cutting in on the line every thirty seconds would severely tax the generators and transformers. He inquired as to the success with electrolytic lightning arresters and as to the size of the insulators. With regard to locating trouble on the lines he wanted to know if the operator plugs the line in on the bus.

P. M. Downing complimented the author on his honesty in tabulating interruptions to service and giving their causes. He commented on the few instances of poles burning out due to leakage over the insulators and spoke of the lack of a satisfactory device for automatically cutting out a line in trouble. Reverse current relays are inadequate when the voltage drops below a certain point. An ordinary induction wattmeter with the disc fixed so that as the current reverses the meter will turn in the opposite direction will indicate in which direction the current is fed and thus shows the line in trouble.

E. F. Scattergood agreed with the practice of tying the generating stations solidly to the transmission lines and not using automatic devices, which are likely to go out together and cause more trouble than they prevent.

G. H. Stockbridge, in speaking on the subject of running the two lines parallel through automatic switches in the substations, asked if experiments had been made on similar paralleling at the generating station. When two lines are running on the same poles he finds it essential that the inspecting lineman ground both ends of the circuit. The burning of poles with the type of insulator employed can be largely eliminated by placing a piece of galvanized iron on top of the lower cross-arm to provide a conductor for the leakage current. Local experience with air gaps has been somewhat unsatisfactory. The discharge point varies greatly with atmospheric conditions, while safe in dry weather it discharges in foggy weather.

Rudolph W. Van Norden spoke of the similarity of problems in operating different plants which should form the best guide for the designing engineer. He instanced particularly the successful Pacific Coast experience with non-automatic apparatus.

C. O. Poole spoke of several features in the Snoqualmie system which illustrates points upon which he has often debated. As to the segregation of multiple circuits by automatic switches he believes that a good non-automatic is much better than a poor automatic. The practice in Southern Nevada has been to install automatic oil circuit breakers on branch lines and also to protect substation devices. These are more reliable on the high-tension than on the low-tension side. He inquired as to whether the circuit breakers would drop after a short circuit due to the line or capacity reactance and as to the method of testing the line, also as to what type of ammeters were used on the high-tension side.

Ralph Bennett stated that when safety devices were installed on the high-tension side of a delta-connected 100,000-volt system, the surges broke down

the installation. They have experienced little or no trouble at such high voltage.

C. L. Cory also spoke of the value of these definite and accurate records operating facts in arriving at effective conclusions.

Electricity in the Lumber Industry.

E. J. Barry's paper on "Electricity in the Lumber Industry," in the absence of the author was read by R. W. Sorenson.

R. L. Noggle spoke of the saving in insurance costs accomplished by substituting electrical drive for engine drive in sawmills.

J. A. Lighthipe inquired whether a portable electric saw had yet been devised for the logging camp.

C. Pemschel in a written communication asked for further data on the mill operation, the size of the cut and the feed as well as the edgers. He questioned the use of 75 h.p. motors in driving the planers unless operated as a group.

J. A. Lighthipe and Chairman MacDonald cited a number of instances which proved that 75 h.p. was not too much to drive a planer in a rough lumber camp.

Ralph Bennett cited an electric-driven sawmill installation using 30 h.p. to drive the planers. He also described the conditions at a redwood mill in Southern California. Monorail systems are preferable to storage battery yard locomotives.

Power Diagram Indicator.

Professor Harris J. Ryan briefly explained the theory, construction and purposes of his power diagram indicator for high-tension circuits, Ralph L. Mershon acting as temporary chairman.

E. F. Scattergood inquired as to the practicability and portability of the instrument outside of the laboratory.

C. L. Cory spoke of its value in measuring very small values and showed that the ability to measure .03 watt at 9000 volts corresponded to one-three-hundred-thousandth of an ampere. He traced its analogy to the steam engine indicator and indicated its practical applications.

J. J. Frank pointed out the value of the instrument in measuring losses at high potentials because of its recognition of the wave-shape, which is not done by the spark-gap.

R. L. Mershon asked information on a simple method of obtaining a known load to calibrate the instrument. He wished to know if measurements had been made as to the effect of moisture on the corona. He also expressed his admiration for the paper and the work it evidences. He sees in it particularly a valuable start in the solution of the insulation problem, which seems to depend upon getting away from organic materials.

Professor Ryan stated that arrangements had been made for manufacturing the instrument in a fairly portable form. He explained how by means of a synchronously revolving mirror it can be used to study wave-forms and briefly answered the other questions which had been asked.

Professor Ryan then abstracted Professor Adams' paper on the economy and limiting value of voltages as illustrated in a number of curves shown.

Mr. A. H. Babcock then took charge as temporary chairman while a paper was read descriptive of the 1200-volt railway of the Central California Traction Company as written by S. L. Napthally.

C. H. Masson told of the inception of this road and Ralph Bennett also spoke briefly.

The Status of the Consulting Engineer.

Chairman A. H. Babcock at this point introduced a subject which was touched upon by Mr. L. B. Stillwell in the meeting at San Francisco a year ago, on the growing tendency of the manufacturing companies doing consulting engineering work free of charge for their customers. The reasons given for this is that in the beginning there were no college courses covering this work as there was no science to be taught. All investigation and experimental work was carried on in the factories, the only places where information could be secured. The manufacturers have therefore become accustomed to furnishing charts with all sorts of information. President Stillwell's remarks led some to believe that some sort of concerted action would be taken in the East if not in the West to change this relation between manufacturer and purchaser.

Mr. Mershon advanced the opinion that no action had so far been taken. He expressed the opinion that it was an economic subject, that if the consulting engineer be an economic superfluity, he at least should get out of the business. The question is therefore is or is he not an economic superfluity. If not, something should be done at once.

Manufacturers are heartily in favor of having work done by the consultant, as the expense of this work where they have to bear it, is heavy. Concerted action is necessary either to abolish this free work or make a regular schedule of charges.

Recently there has been organized the American Institute of Consulting Engineers, they should take this question up carefully if they show that their existence is justified then they should take up the matter with the manufacturers. Many of the engineers in the employ of the manufacturers expect eventually to go into independent consulting work, if there is no work for them to do another complication is introduced.

Mr. Mershon explained that what he said was not in extenuation of the cause of the consulting engineer but to set engineers thinking on a proper solution of the problem, either for or against.

Mr. Babcock then took up the subject from the point of the engineering student. He said that college graduates were not, as a rule, self-reliant enough to succeed in their work, in other words there must be a period of several years of seasoning. It is perfectly natural for the young engineer to lean toward the manufacturer for his sources of information and eventually become dependent on him. The manufacturer in turn expects something. This is absolutely destructive to independent thought and action. Good character is the only guide as to how far it is right to depend on the manufacturer, in other words a man's conscience must tell him what to do.

Mr. Ensign gave examples of where bids for equipment differed greatly and how an absolute knowledge of conditions governing the situation was necessary on the engineer's part to form a decision. Mr. Scattergood, brought out the point that the profession as a

profession had a purpose and should not be controlled by industrial conditions. He showed where engineering work for a company done by its own engineer will give better results than that done by the engineer of the manufacturer who is building apparatus for the company. One reason is that the manufacturer is too far away and his engineer is not familiar with the local conditions, the other is that his greatest enthusiasm is naturally toward the manufacturer, his employer is an influence which prevents the sort of development work and healthy conditions toward the company which would otherwise prevail. Corporation engineers are continually being imposed upon through friendship to members of the corporation or otherwise. These people get free advice and then employ cheap and poor talent to carry out work. Here however the corporation engineer has the opportunity to refer the applicant to a consulting engineer, thus saving his time and putting the work where it legitimately belongs.

Mr. Scattergood hoped that the same free expression of opinion on this subject would prevail in Eastern meetings.

Professor Harris J. Ryan of Stanford University then took up the matter, as relating to college work. He said that the co-operation of consulting engineers with the college men was of greatest importance, especially in tiding over the two or three years of uncertainty after graduation. The manufacturers are of great help here and the work in the factories gives experience and reliance. The colleges are trying to prepare the student to safely cross this time of uncertainty and welcome co-operation.

Mr. Babcock gave instances of his advice to college men who applied for positions with his company. He said that he told them to take the students' course with a manufacturing company for two years and then bring in his application.

Chairman McDonald then took the chair and in a few well chosen words thanked the members for their eager participation in the discussions, etc.

Mr. Mershon remarked that if the presence of the eastern members were necessary to the success of these meetings, he hoped that condition would continue to obtain.

Mr. Scattergood reiterated his belief in the importance of these meetings and regretted that President Jackson could not have attended.

The chairman called attention to several letters from members regretting their inability to attend and read one in particular from President Jackson.

Letters were also received from Messrs. L. B. Stillwell, Sprague, Murray, Dunn and Jackson of Chicago. The convention was then adjourned with instruction to the members to meet the following morning at 8:30 at the Arcade depot of the Southern Pacific for an all-day trip to the Edison Company's plant in San Bernardino County.

The Riverside Trip.

The last day of the session was given entirely to entertainment and from this point of view was destined to be the crowning event. For this day the members and their wives and ladies were to be guests of the Southern California Edison Company.

The party boarded a special train of four cars on the Southern Pacific road, at 8:30 a. m. There were 220 all told and it made a merry train load. The ride of two hours through the San Gabriel Valley, through the orange orchards was a source of constant admiration to those who had never been through the section. At Pasadena a brass band welcomed the special with lively tunes, and hundreds of oranges and masses of roses were distributed to the party.

The party passed through the city of Redlands and disembarked at the Union Ice Co.'s plant near Mentone. A short visit was made here for the purpose of viewing the first three-phase synchronous motor ever built. This motor drives an ice-machine and has been in daily operation for 17 years. The development of long-distance transmission started at this point and the motor was naturally of great historical interest to the engineers present.

Waiting for the party at this point were automobiles, tallyhoes, carry-alls, and almost every sort of comfortable conveyance which could be procured in the county, for the transportation of the party to the power plants, about thirty conveyances in all. From this point the drive was through a wild uncultivated country, following a steady rise, a distance of six miles. The drive while slow, was a delight as the day was perfect, the air clear and the view of the mountains, culminating in the peak of San Jacinto a magnificent spectacle not soon to be forgotten.

The party then left to retrace part of the way to Mill Creek No. 1 where lunch was served. And about this time the lunch was more important than all of the power houses on earth. It was a wonderful lunch. Spread out in two long lines under the trees were the tables and on them was almost everything, at least it looked that way. First there was fried chicken, it was said that one hundred and forty-five of them were served, then there were cold meats of all sorts, all one could eat, then there was asparagus and olives, and salads and hot biscuits and finally real good old-fashioned strawberry short-cake, big plates of it with lots of strawberries.. It is rumored that several of the San Francisco delegation who were sitting near the heads of the tables, after they had finished all they were supposed to eat, went down to the other ends, pretending they were late comers and had lunch all over again.

The return was made through the orange groves to Redlands where the special train was in waiting.

The hosts had arranged many pleasant surprises for the benefit of the party, but here Mr. Lighthipe gathered the party together and then ordered a special eclipse of the sun for their benefit, which was greatly appreciated.

The special was again boarded and the party was landed at Riverside, going to the "Mission Inn" for dinner and entertainment.

It was with the greatest reluctance that the party dragged themselves away at 9:00 o'clock to again enter the special for the return.

Stragglers late that night stopped to look and listen to the happy crowd which filed through the Arcade depot, all swelling the chorus of "Auld Lang Syne," a reflection of the pleasure afforded by the hosts under the care and leadership of Mr. J. A. Lighthipe and B. F. Pierson.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Consulting Engineers Not an Economic Superfluity

An impromptu discussion during the Institute meeting at Los Angeles regarding the sales engineer's encroachment into the consultant's practice was ably epitomized by Ralph L. Mershon in the leading question, "Is the consulting engineer an economic superfluity?" The answer to this impersonal query is vital to the future of engineering development; it can be solved by an equally unsentimental analysis of existing conditions, for it requires merely proof of the fact that there is work for the consulting engineer and that he is the best qualified for its performance.

If judgment were based upon the recent idleness of many of the profession, it might seem that they are not needed for much of the engineering work now being done; or at least that the men paying for the work do not recognize the important function of the consultant as distinguished from the sales engineer who supplies apparatus or from the operator who runs it. It can be but a matter of a few years, however, before the mistakes thus made may demand competent rectification and engineers will be as busy patching the old as planning the new work.

The consulting engineer is a judge, not an advocate. He is as likely to advise against as in favor of a project. If his opinion is favorable it is his province to devise the most feasible method of development. He must be able to form a mental image of the completed installation as an artist does of a picture he has yet to paint. His skill consists in the pre-determination of equipment and methods. He is necessarily a man of broad and varied experience and possessed of a specialized knowledge which guides him in untried fields and enables him to meet unusual conditions.

The engineer for the manufacturer is as obviously unfitted for such discrimination as is the attorney for the defense disqualified from charging the jury. Yet in his limited field the salesman with engineering knowledge can be of great value to the purchasing client because he knows what apparatus is best adapted to certain needs. The fault, if there be any, lies not with the sales engineer, but with the buyer who is not as familiar with engineering as with law, and who consequently does not realize that while he may confer with the salesman he should consult with an independent engineer.

The work of the consulting engineer is as important and distinctive as that of a federal judge or of an architect. His horizon is broader than that of the specializing salesmen and his judgment is correspondingly sounder. He is most emphatically not an economic superfluity, for without him all methods of developing material resources would be decided not by reason, but by sentiment induced by partisan argument.

PERSONALS.

John A. Britton and wife sailed for Honolulu this week.

A. C. Balch of Los Angeles was a San Francisco visitor last Monday.

Thomas Mirk, of Hunt, Mirk & Co., left for San Diego last Monday.

A. D. Page, manager of lamp sales for the General Electric Company, is at Seattle.

Rufus W. Keeler, electrician, recently returned to San Francisco after an Eastern trip.

T. G. Whaling of the Westinghouse Lamp Company returned to New York from the Pacific Coast.

J. B. Hunter, the City Engineer of Denver, Colo., arrived at San Francisco last week on a vacation trip.

R. D. Holabird of the Holabird-Reynolds Electric Company of San Francisco is making a month's trip East.

A. S. Work, representing the Railroad Supply Company at Sacramento, was at San Francisco last Saturday.

Robert Kuhn of the American Electric Heater Company left for Detroit this week, going via Los Angeles.

Guy W. Talbot has been elected president of the Pacific Power & Light Company, with offices at Portland, Ore.

W. W. Low of the Electrical Appliance Company of Chicago sailed from San Francisco last Wednesday for Honolulu.

C. I. Hills of the Franklin Incandescent Lamp Company of New York left during the past week for the East, via Seattle.

Gilbert Woodill of the Woodill-Hulse Electric Company, Los Angeles, spent a few days at San Francisco during the past week.

W. H. Powell, chief electrical engineer of the Allis-Chalmers Company, is visiting the San Francisco office of that corporation.

K. G. Dunn, electrical engineer with Hunt, Mirk & Co., returned to San Francisco last Tuesday after a trip covering Portland, Seattle and Aberdeen, Wash.

H. L. Jackman, general manager of the Humboldt Gas & Electric Company, which is now owned by the H. M. Byllesby interests, recently arrived at San Francisco from Eureka.

C. S. S. Forney, president of the Southern Counties Gas Company, operating plants at Covina, Fullerton, Orange, Anaheim and other towns in Southern California, is at San Francisco.

Williams S. Turner, formerly manager of the Northwestern offices of W. S. Barstow & Co., has opened offices as consulting electrical engineer, in the Spaulding Building, Portland, Ore.

M. L. Dozier, who recently resigned as assistant general manager of the Northern Electric Railroad Company, recently visited San Francisco. He will engage in business for himself at Sacramento.

J. B. Rowray has resigned as superintendent of the north division of the Pacific Electric Railway of Los Angeles to become superintendent of the Northern Electric Railway of Chico, Cal.

L. B. Cramer, electrical engineer of the Oregon Electric Railway Co., inspected the high-tension power plants of San Francisco and vicinity after attending the American Institute sessions at Los Angeles, and departed last Monday for Portland.

J. D. Schuyler, a hydraulic engineer of Los Angeles, who has been connected with important hydroelectric projects on the Pacific Coast and in foreign countries, was a San Francisco visitor last week.

C. W. Koiner, of Pasadena, has been engaged by the City of San Bernardino, Cal., to value the power plant and distributing system of the Lytle Creek Power Co., with a view to purchasing the property.

Louis C. Kelsey, civil engineer, Selling Building, Portland, Ore., has been employed by the city of Elma, Wash., to prepare plans, specifications and estimates for increasing the water supply by means of pumping. Bids for construction will be invited later.

Paul C. Funk, formerly superintendent of the gas department of the Coast Counties Light & Power Company, and more recently manager of the Tonopah Gas Company, is now with Van E. Britton, gas engineer, as construction foreman, at Willows, Cal.

A. M. Hunt has been appointed by the San Francisco Board of Works as consulting engineer, at a salary of $300 a month, to direct the construction of the Geary-street municipal railroad. He assisted in the preparation of the original electric railway data when the project was first taken under consideration several years ago.

The Electric Club of San Francisco, which is composed principally of United Railroads power station operators, gave an annual banquet on Monday, April 24th. Mr. W. T. Bivins, Chief Engineer of Electrical Equipment of the United Railroads of San Francisco, was their guest. The members present were: F. W. Bruckmann, O. E. Davis, J. L. French, H. L. Hiett, W. F. Lange, W. V. Smith, J. M. Williams, E. H. Zenner.

OBITUARY NOTICE.

Albert C. McDavid, who was well known in Central and Northern California as right-of-way agent for the Pacific Gas & Electric Company, died from heart failure at Smartsville a few days ago. He was 36 years of age and left a widow, who was formerly Miss Katherine Dyer of Sacramento. The remains were sent to McDavid's old home in Illinois for interment.

TRADE NOTES.

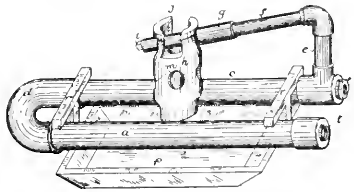
The Union Gas & Electric Company of Cincinnati has just placed with the General Electric Company at Schenectady, N. Y., the largest single order for arc lamps ever received by a manufacturer. This order calls for 6000 of the company's latest type of series luminous arc lamps, together with a complete mercury arc rectifier station equipment of 9000 lamps capacity.

The Pelton Water Wheel Company has been awarded the water wheel contral for the new "booster" installation for the municipal lighting system of Seattle, Wash. A 2500-h.p. Pelton-Francis turbine, of the overhung spiral-case type, operating at 720 r.p.m., under a head of 380 feet, will be installed. Water will be taken from the city reservoir at Volunteer Park and dropped to Lake Union, where the generating set will be located. It will be automatically controlled from a substation two miles away.

Van E. Britton is installing for the Northern California Power Company at their plant at Red Bluff a high pressure boosting system consisting of a Rix enclosed type compressor, motor driven with two storage tanks, and about a mile of high pressure pipe, which bisects the city, and is tied in at necessary points with the present low pressure distributing system by means of reducing governors. By means of this installation a constant and uniform pressure will be maintained at all times on the low pressure system regardless of the consumption.

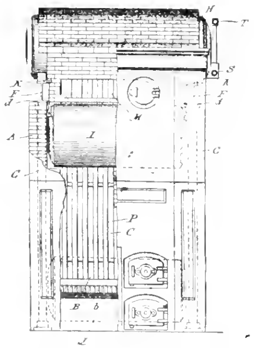
PATENTS

990,331. Hydrocarbon-Oil Burner. Charles W. Brewbaker and George R. Shanklin, Portland, Ore.; said Brewbaker assignor to Ella M. Brewbaker, Portland, Ore. In a hydrocarbon burner the combination of a retort consisting of a horizontally arranged U-shaped pipe, the parallel members thereof being spaced apart; a riser from said retort, a horizontal pipe-extension from such riser to approximately the center of the retort, the outer end of such pipe-extension being closed and having a bottom discharge orifice located centrally above the



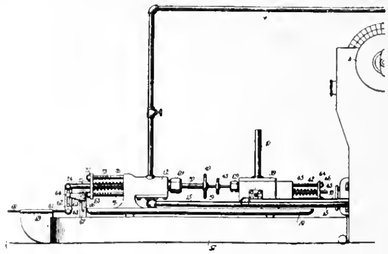
retort; a mixing chamber suspended from said horizontal pipe-extension of the retort and under the discharge orifice of said pipe-extension, said mixing chamber comprising a hollow body open at the bottom and provided with air apertures, one or more, in its sides; and a nipple of smaller cross section than the mixing chamber suspended centrally within the mixing chamber; the lower end of said nipple extending below the air apertures in the sides of the mixing chamber; and the parts being arranged to position the inlet end of the nipple below the orifice of the horizontal pipe-extension of the retort.

990,622. Steam-Generator. John P. Badenhausen, Seattle, Wash. A steam generator comprising uprights having longitudinally-disposed channeled seats at their upper ends, longitudinal beams superposed on the said uprights and disposed in the said channeled seats thereof, saddles resting on the said



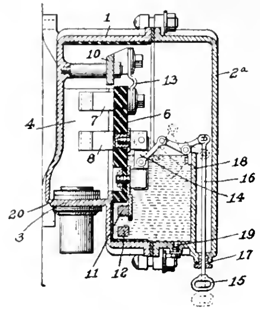
longitudinal beams, hangers connected with the beams, and spaced drums connected together and communicating with each other; one of the said drums resting in the said saddles, and another drum being connected to the said hangers.

990,744. Fuel-Oil Regulator. Edgar Mawer Jones, Morenci, Ariz. A fuel oil regulator, comprising a steam casing having an inlet and an outlet orifice; an oil casing having an inlet and an outlet orifice; slide valves mounted in said casings and arranged to close said outlet orifices; a connecting rod uniting said valves; a piston head mounted in a steam chamber in open communication with the pressure chamber connected with the surface to which fuel is being supplied through the said regulator; an air duct for supplying air to



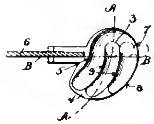
said furnace; an intake valve for said duct; and means for operatively connecting said intake valve with said piston head to operate in unison with the said first mentioned valves.

990,235. Junction-Box Structure for Electrical Conductors. Charles W. Davis, Edgeworth, Pa., assignor to Standard Underground Cable Company, Pittsburg, Pa. A junction box for multiple-conductor cables consisting of a casing, a partition extending upward from the lowermost wall of the casing and dividing the space within, the space on one side of said



partition being further divided into a plurality of separate compartments, and an orifice for the introduction of a cable formed in the junction-box wall and opening into each of such compartments, and pole-pieces extending through said partition and into each of said compartments, substantially as described.

990,362. Impact Water-Wheel. John Kincaid, Vancouver, British Columbia, Canada. In an impact water wheel, a cup for the reception of the water jet the side of which cup into which the jet is received being approximately a spherical seg-



ment and thereafter in plan curving inward around the edge of the wheel to which the cups are secured toward the axis of rotation, and a series of sharp edged ridges in the bottom of the cup following generally the curvature of the outside edges of the cup.

INDUSTRIAL

A NEW TYPE OF SYNCHROSCOPE.

The infallibility and simplicity of the lamp method of synchronizing machines has kept it from being displaced by the rotating synchroscope. In fact, the rotating synchroscope is usually used in conjunction with a synchronizing lamp in order to guard against disaster in event of failure of the synchroscope. However, this arrangement is unsatisfactory, since it requires the attendant to divide his attention between two objects.

The lamp method, when the lamps are connected to synchronize light, gives an accurate indication of the equality of frequency, but the phase displacement which must be judged by the brightness of the light can be determined only in the roughest sort of a way. For instance, it requires a phase displacement of 16 degrees to produce a change in e. m. f. across the lamp of 1 per cent; therefore, a slight error in the judgment of the brightness of the light may cause considerable shock when the machine is thrown onto the line.

The Weston Electrical Instrument Company has recently brought out a new type of synchroscope, which is so combined with a synchronizing lamp as to be infallible and at the same time it gives precise indication of the phase difference between the two machines to be synchronized.

This synchroscope consists of an electrodynamometer movement similar to the new Weston single-phase wattmeter, which was described in our issue of April 15, 1911. The movable and fixed coils are both wound with fine wire; a condenser is connected in series with the movable coil and a slightly inductive resistor is connected in series with the fixed coil. This movement is combined with a synchronizing lamp mounted inside the case and behind the dial. The lamp is connected across the secondary of a special three-legged transformer, the primaries of which are connected to each of the circuits to be synchronized. The connections are shown in Fig. 4. The condenser, transformer and resistor are mounted in a separate box.

It is well-known that a good wattmeter will show no deflection, when the current and e. m. f. are in exact quadrature; that is, when the currents in its two circuits are in exact quadrature. In the present instrument, by properly choosing the constants of the two circuits the currents in these circuits can be brought into exact quadrature when the e. m. f.'s of the two machines are exactly in phase; that is, a good electrodynamometer movement when connected in this way is capable of handling phase coincidence with great accuracy.

Fig. 1. Front View Synchroscope.

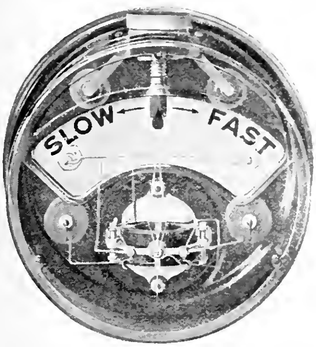


Fig. 2. Phantom View.

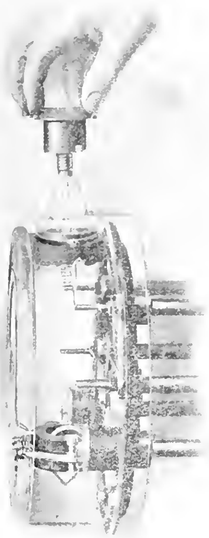


Fig. 3. Phantom view showing the relative position of the lamp, pointer and scale.

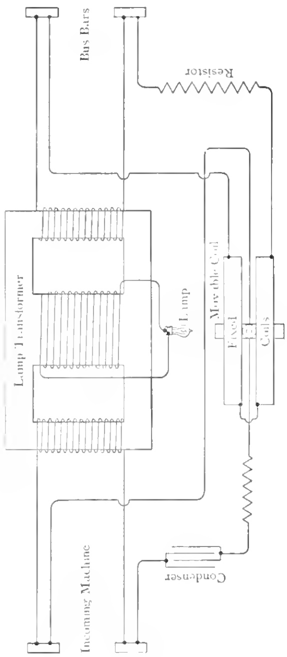


Fig. 4. Circuit diagram.

With this arrangement alone there would be no way of distinguishing phase coincidence from phase opposition, and also no way of determining whether the incoming machine is fast or slow when the frequency is not right. In the Weston synchroscope these highly desirable characteristics are attained in a most ingenious way, namely: by mounting the pointer behind a translucent glass scale and illuminating it from behind with a small synchronizing lamp.

The pointer stands normally in the middle of the scale

and is deflected to the right or left, depending upon the direction of the resultant torque; that is, upon whether the current in one circuit lags or leads with respect to that in the other. Therefore, when the frequency of the incoming machine differs from that of the line, the relative phase position of the two waves will vary continuously through complete cycles of 360 time degrees; each cycle corresponding to two reversals of the torque and thus the pointer will swing back and forth over the scale. However, on account of the lamp which glows only during that part of the cycle while the waves are in approximate phase coincidence, the pointer is seen only during every other swing; that is, it appears to rotate continuously in one direction or the other. The direction of apparent rotation depends on whether the incoming machine is fast or slow and the speed of rotation is a measure of the amount by which the frequency differs from that of the system.

It is not immediately apparent why the direction of apparent rotation indicates fast or slow. Probably the best way to demonstrate what goes on is to plot two waves that differ in frequency and then construct the torque curves which cause the motion of the pointer. This has been done in Fig. 5. The

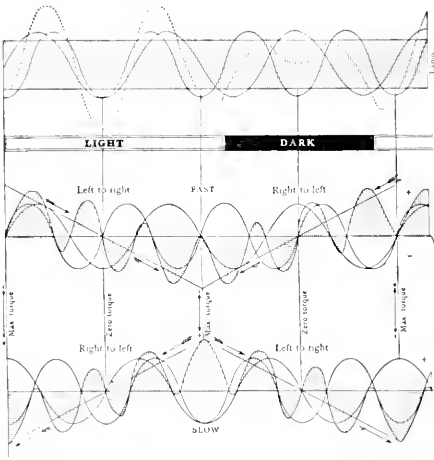


Fig. 5 Diagram showing relation between current torque, speed, phase, etc.

two waves at the top are those impressed across the two primaries of the lamp transformer and the resultant, which is shown dotted, represents the current through the lamp. It requires a certain value of current to make the lamp glow and it has been assumed that when the maximum value of the current does not fall outside the limits of the shaded area that the lamp would remain dark. The periods of light and darkness are shown below the top set of curves.

The middle set of curves is constructed from the upper set by assuming the fast wave to be that of the incoming machine and, therefore, it is shifted ahead 90-time-degrees or a quarter period. These currents are active in the coils of the instrument and the torque is equal to their instantaneous product. These products have been taken and are plotted as curves bounding the shaded areas. It is seen that zero torque occurs simultaneously with maximum light and maximum darkness and that the maximum positive and negative torques occur at the transition points between light and darkness; therefore, the pointer is seen only while swinging to the right and appears to rotate in that direction when the incoming machine is fast.

The lower set of curves is exactly similar to the middle set, except that the slow wave has been considered as belonging to the incoming machine. In this case the pointer goes from right to left during the period of light. These indications are absolutely infallible, since the pointer can be seen only in shadow on the translucent glass scale by light from the synchronizing lamp.

When the frequency is right the torque will cease to fluctuate and the pointer will come to rest. The value of the torque depending upon the amount by which the e. m. fs. of the machines differ in phase. The deflection per unit phase displacement is large and fairly uniform, except at synchronism where it is very large. A displacement of 5 degrees from synchronism will produce a deflection of ½ inch.

The chief advantage of this synchroscope is its infallibility; however, it is also extremely accurate and convenient to use. There being no sliding contacts the rotation is smooth, steady and continuous up to the very instant of exact synchronism.

The accuracy is practically unaffected by changes in frequency and voltage over a wide range of variation. For instance, a 110-volt, 60-cycle synchroscope under test from 40 to 80 cycles and from 95 to 130 volts indicated true synchronism within 1 degree phase difference.

NEW WESTINGHOUSE ENGINE-DRIVEN INTERPOLE GENERATORS.

The increasing use of electric power demands overload capacities in direct-current generators, together with sparkless commutation and the highest degree of mechanical excellence. The new standard line of Westinghouse Type Q interpole direct-current generators thoroughly fulfills requirements and furnishes the most desirable engine-driven generator yet produced for direct-current two-wire or three-wire service.

Prominent characteristics of Type Q generators are interpole construction, thorough ventilation and ruggedness with relatively light weight. The interpole construction provides perfect commutation, with a definite brush position covering all ranges of load. Heavy overloads may be imposed without sparking or flashing and wear on commutators and brushes is reduced to a minimum. The ventilation of all current-carrying parts and of the armature cores of type Q machines is such that there can be no hot spots at points dangerous to the insulation. The frames are of cast steel, a material of high magnetic permeability, which furnishes ample strength with economy of both weight and space, contributing to good ventilation, low freight charges and easy handling.

The rotors or armatures of type Q generators are designed for direct mounting on the shaft of the prime mover, which may be of any type of suitable speed. The stators or fields are arranged for mounting on masonry foundations or directly on the bedplate of the prime mover.

Ventilation has received particular attention in the design of these machines. The design of all the windings is such as to give shallow coils with the result that the heat in any part has but a very short distance to travel to the surface from which it is radiated. This, with very complete and thorough system of air circulation, insures an entire absence of hot spots and a uniformity of temperature never before obtained in similar machines. These features enable these generators to stand heavy overloads without injury.

Type Q generators are standardized for desirable and usual ratings from 25 kilowatts to 1000 kw. with speeds conforming to the best engine practice. Up to 100 kw. in capacity the standard voltages are 125 or 250. From 100 to 300 kw these machines are wound for 125, 250 or 600 volts, and from 300 to 1000 kw. they are wound for 250 and 600 volts. Machines of 250-volt rating are regularly equipped for three-wire operation.

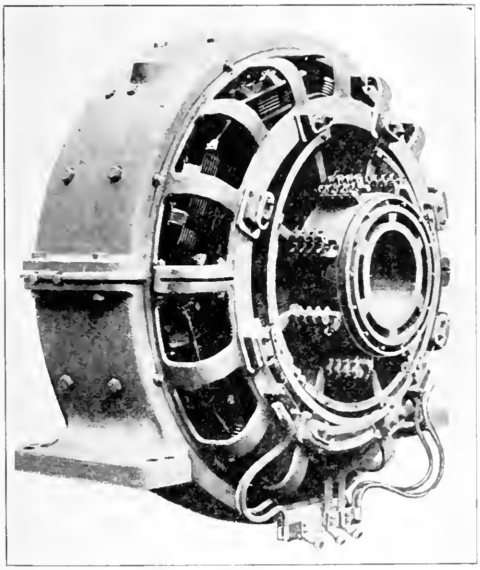
Most electrical troubles in a direct-current generator arise from faulty commutation, especially during overloads. They begin with sparking, which burns away the copper and brush, causing high mica, roughness of surface, flashing, break-downs in installation and deterioration in brushes, brush holders and commutators.

In a non-interpole generator, sparking is primarily due to a local magnetic field surrounding a coil which is being commutated. This field sets up an e. m. f. in the commutated coil, in such a way as to oppose the reversal of the current in the coil, and thus tends to cause sparking as the coil or commutator bar leaves the brush. The action increases with the current or load and is especially destructive on heavy overloads.

In a non-interpole machine sparkless commutation may be obtained if the brushes can be so located that the armature coils shortcircuited by them are brought into a magnetic field of exactly the right direction and strength to neutralize the effect of the local field at the moment of commutation.

Such a field is found to exist near the tips of the pole pieces and it has been customary to advance the generator brushes sufficiently to bring the armature coils within it during commutation; but this field varies in strength under various conditions of load. Instead of becoming stronger as desired with increase of load, it actually becomes weaker.

In type Q generators the proper conditions for commu-



Westinghouse Type Q Generator.

tation are obtained by the use of small poles, interspaced between the main poles. The interpoles have their windings in series with the armature and set up a magnetic field which annuls the effect of the field formed by armature magnetization and generates in the commutated coil an e. m. f. which assists the reversal of the current. Since the interpole coils are in series with the armature, the interpole field strength varies in proportion to the load and it thus has the proper corrective effect at all loads.

Since the e. m. f. due to the interpole, which assists reversal, has a definite position under the interpole, the coil being reversed must be located accurately with respect to this reversing e. m. f. Therefore, the correct position of the brushes must be determined accurately before the generator is put in service. When this point has been properly located, shifting the brush position is not only unnecessary but detrimental. With Westinghouse development of the interpole principle, experience has proven that sparkless commutation is obtained under practically all conditions, from no load to very heavy overloads.

A NEW LINE OF CONVERTIBLE SWITCHBOARDS.

The Western Electric Company has just placed on the market a new line of telephone switchboards, which will fill a long-felt want among small telephone companies. This type, known as the Magneto Convertible Non-Multiple Switchboard, is so designed that it can be used originally for magneto service and then converted at will for central battery operation.

These convertible switchboards are recommended for use in new exchanges where the present conditions call for magneto service, but where central battery service will eventually be used. Their use makes possible the greatest economy right at the start when magneto service is required. Later when it becomes more economical to operate the exchange on a central battery basis the common battery lines can be added as needed, and the switchboard will operate just as economically as a central battery equipment. Oftentimes it is advantageous to make this change from magneto to central battery gradually. This convertible switchboard allows both kinds of service at the same time.

The magneto exchange requiring additional lines to take care of its growing business until the time when it will find central battery operation more economical, will find these convertible switchboards great money-savers. One or more sections equipped for magneto service can be installed, and when the time comes for changing to central battery operation the transition can be made without any loss of equipment.

These switchboards are made in two sizes, the No. 1255, having a capacity of 330 magneto or common battery lines, 30 pairs of cords and 30 transfer circuits, and the No. 1246, having a capacity of 165 magneto or common battery lines, 15 pairs of cords and 15 transfer circuits. They are so designed and constructed that any number of sections can be readily lined up together, so as to make a switchboard with several positions without making a single change in the woodwork of the cabinet, and the sections when so arranged present the appearance of one continuous cabinet.

An important feature of these switchboards is the cord circuits These circuits are extremely flexible, for, without disturbing the wiring of the board and adding but a few pieces of apparatus five different combinations can be made, as follows:

1. Straight Magneto (without condensers).
2. Magneto with "non-hang-up" feature.
3. Combination cord circuit capable of connecting two magneto lines or one magneto line and one central battery line.
4. Special combination cord circuit, capable of connecting two central battery lines, one magneto line and one central battery line.
5. Universal cord circuit, capable of connecting two magneto lines, two central battery lines or one magneto and one central battery line.
6. Straight central, capable of connecting two central battery lines.

Any of these changes can be made easily and quickly. For example, the addition of the converting relay, which changes the cord circuit from magneto to common battery operation, is made by simply cutting the loop wires back of the switchboard and soldering the relay. To change any line from magneto to central battery operation is equally simple. It is only necessary to change a couple of strap wires on the signal itself.

The well known combined jack and signal, used in the company's No. 1800 type switchboard, is used in this board, and most of the apparatus used is standard, having been employed in many of the company's switchboard circuits for years.

These magneto convertible switchboards are characterized by easy and economical operation, accessibility of all parts, low maintenance expense and are readily adaptable to every service condition.

NEWS NOTES

FINANCIAL.

HAINES, ORE.—By a vote of almost three to one Haines taxpayers have voted in favor of a $20,000 bond issue for the purpose of installing a city water system. The City Council will advertise for the bonds at once.

ELMA, WASH.—The clerk has been instructed to advertise for bids for $10,000 bond issue, the date of opening the bids being fixed for Tuesday, May 16th. The funds are to be used for the betterment of the water supply system. Louis C Kelsey of Portland is to plan the work.

MORGAN HILL, CAL.—At the meeting of the Board of Trustees last week an ordinance was introduced and rel ferred to the ordinance committee consisting of Trustees Baird, Beach and Lynch, caling a special election to submit to the voters of Morgan Hill the question of voting $13,000 bonds for the acquisition, construction and completion of a system of water-works for the town.

ALAMEDA, CAL.—Bonds to the amount of $175,000 will probably be issued by this city within the next few months to raise money for several necessary public improvements. The municipal electric light plant needs $100,000 for a new building and new machinery, the fire department has made application for an automobile ladder truck, the school department asks for $3500 for the purchase of the lot adjoining the Porter school, and the water front committee ask for $10,000 for the construction of a municipal wharf on the city estuary front property at the foot of Grand street. A special bond election will probably be held in July.

ILLUMINATION.

OREGON CITY, ORE.—A. L. Beatie has presented a 25-year gas franchise.

EVERETT, ORE.—The Everett Gas Company has asked for a franchise for the construction, maintenance and operation of gas pipes and gas mains upon streets in this city.

NEWBERG, ORE.—The local electric company is contemplating extensive improvement to its plant in the near future. Manager Edwards states that the increasing business necessitates heavier machinery.

SAN JACINTO, CAL.—Plans are being carried out for extension of the electric lighting system of San Jacinto. New and more powerful engines will be installed at once and electricity will be furnished for operating pumping plants, as well as for lighting purposes.

MADERA, CAL.—F. C. Roberts has made application to the Board of Trustees to lay gas pipes, mains and conduits in all of the streets, alleys and highways of the city of Madera. Sealed bids will be received by the Board up to 7:30 p. m., May 13th, 1911, for the sale of this franchise.

REDWOOD CITY.—The United Gas & Electric Company has started the construction of a light and power line to Woods. It will extend northward to the Josselyn place and southward to the Family Club. The line will cost about $10,000. The gas and electric company announces that the rate charged for gas on the peninsula will be reduced during the next month to $1.25 per 1000 cubic feet. The present rate is $1.50 per 1000.

WILLOWS, CAL.—All of the material and machinery for the Willows gas plant is on the ground, and unless some unforseen event occurs it will be making and distributing gas by June 1st. More than half of the mains have been laid, and the service gang will begin work next week connecting up the various consumers. Davis & Farnum Mfg. Company who have the contract for the erection of the gas-holder which is of the steel tank type, are rushing the work with all possible speed, and by the end of next week will have the tank portion completed. The material for the holder part has already been shipped from the factory.

SACRAMENTO, CAL.—Electrical current was turned into the second district underground system being completed by the Sacramento Electric, Gas & Railway Company for the first time last week. The system was found to work well. The second district of the underground system, just being completed, lies between Front and Fifth streets. As soon as the new system is in constant use poles will be removed between Front and Fifth in the business district. Workmen are now engaged in excavating for the underground system of the third district, between Seventh and Twelfth streets, the first district between Fifth and Seventh having been completed for some time.

BAKERSFIELD, CAL.—Work will begin immediately on the first of the sub-stations to be built at different points in this section of the county by the San Joaquin Light & Power Corporation. Moron and Maricopa have first call, the site being so situated as to serve both communities and the surrounding country. George R. Stebbins, who has been for some months foreman of construction at the power plant in Bakersfield, has left that work and will be in full charge of sub-station construction, although all of it is under the supervision of General Superintendent Peart. When the Maricopa-Moron house is finished Stebbins will build another at McKittrick and after that Famosa will be provided with a station. Each building will be constructed of steel and concrete, will cover an area of 50x30 feet and will be 30 feet high.

PORTLAND, ORE.—The Pacific Power and Light Company has purchased all the properties of the following companies, and hereafter they will be operated by and in the name of Pacific Power and Light Company: Hood River Light and Power Company, electric light and water systems at Hood River, Oregon; Klickatat Light and Power Company, electric light system at Goldendale and Centerville, Washington; Tucannon Power Company, electric light systems at Pomeroy and Marengo, Washington; Dayton Electric Company, electric light system at Dayton, Washington; Waitsburg Electric Light Company, electric light system at Waitsburg, Washington. The construction department is now at work building 22 miles of 66 kv. line between The Dalles and Hood River, Oregon, and the company expects to begin construction on approximately 75 miles of 66 kv. line which will connect the present system at Walla Walla to Waitsburg, Dayton, Prescott, Turner, Marengo and Pomeroy, hoping to have this line finished by September.

TRANSPORTATION.

REDDING, CAL.—Five thousand dollars will be raised in Shasta County as its share toward making a reality of the west side electric road from Woodland to Kennett.

PORTLAND, ORE.—Terminal facilities for the Oregon Electric road have been secured in McMinnville, to which place a branch line from the main road, running south from Portland, will be built.

SAN JOSE, CAL.—A great suburban loop on the eastern side of the Santa Clara valley, similar to the Saratoga-Los Gatos loop on the western side, is one of the first railway extensions proposed by the new owners of the Hanchett system.

SAN FRANCISCO, CAL.—Plans for a local electric service between this city and the Haggin Grant have received a temporary setback through the refusal of the Northern Electric to allow the use of its bridge over the American River to the Sacramento Electric, Gas & Railway Company.

PASCO, WASH.—A. M. Wehe, of Milwaukee, is gathering data regarding the feasibility of constructing an electric street railway here and eventually extending it to Pendleton, Ore., and Walla Walla points. If the deal is consummated the enterprise will be backed by Milwaukee capitalists.

OAKLAND, CAL.—An ordinance has been granted to the Oakland Traction Company for a 35-year franchise to lay down and operate a street railroad with all necessary convenient side tracks, switches, connections, poles, wires and appliances to be operated by electricity over certain streets in Oakland, beginning at Hopkins street.

GLENDALE, CAL.—E. Goode, builder and former owner of the Glendale & Eagle Rock Railway, is planning several street railways for this section. The largest project will be known as the Everett Railway, which will connect with the Yellow Rock car line at Glassell ranch and will run from there to Workman ranch to Haines property in Glendale, from there it will run along Eighth street to Everett, to Fourth street, along Fourth street to Glendale avenue, to connect with the Glendale-Eagle Rock line. Another will run from Haines' property to Scholl canyon, and another from Fourth and Brand Boulevard to Griffith Park.

OAKLAND, CAL.—Within a month the Southern Pacific Company will commence the reconstruction of the Seventh street tracks to make the line part of the local electric railroad system which is fast being installed by the company. As soon as the necessary material arrives on the ground the erection of poles for the carrying of power wires will be rushed through. Surveyors are now at work at different points along Seventh street getting the necessary data for the engineers to commence work. Before the end of the month contracts will be let by the Southern Pacific for the paving of the thoroughfare for its entire length in accordance with the terms of the franchise granted by the City Council. The company will also pay for the lighting of the street during the life of the franchise and in addition will pay $5000 a year for 15 years and $8500 annually for 20 years to the city for the privilege of the franchise. Surveys and other preliminary work are being carried on at the Sixteenth street station, where the new $300,000 passenger depot is to be built in connection with the main line and the Berkeley local electrical system.

OAKLAND, CAL.—W. R. Alberger, vice-president of the Oakland Traction and Key Route Companies, has been appointed to succeed W. F. Kelly, resigned. Numerous other changes in the personnel of the officials of the two companies were made at the meeting of the directors. Alberger will still retain the position and title of vice-president. The position of general manager and that of assistant general manager are to be abolished when Kelly leaves his work. Alberger will assume the general supervision of both companies. The active management of the two corporations will remain in the hands of the executive board, consisting of F. M. Smith, E. A. Heron, Alberger and a few others. These men have at all times been in control of the systems of the two concerns, despite the fact that officials have been appointed as the heads of these departments. J. Q. Brown, who acted as assistant general manager to Kelly, was appointed to the position of superintendent of all the engineering departments, chief engineer of mechanical and electrical departments and purchasing agent for both companies. Edwin M. Boggs, who has been with both corporations for many years, was appointed to the position of chief engineer of construction and maintenance of way. J. P. Potter, superintendent of the systems, was appointed general superintendent of the marine and rail transportation departments.

MODESTO, CAL.—The Tidewater & Southern Railroad has come out with a definite announcement which means that the Modesto Interurban line, the tracks of which are already laid from this city to Empire, will be in operation within 90 days, and the proposed line between Modesto and the Stanislaus River to the north will be rushed to completion and also running within a few months. An interurban line, 14 miles in length, will be constructed at once and operated on the completion of the construction from the Stanislaus River on the north through Modesto, to Empire on the east. Byron A. Peirce, as general manager of the company, makes the announcement that capital stock in the railroad will be sold at the rate of $1 a share, and that positively all the money secured in this manner will be devoted to the construction of the line from the Stanislaus River to Modesto, a distance of seven miles, and the equipment of the line from this city to Emprie. Twenty-five per cent of the funds are to be paid at the time of the purchase of the stock, 25 per cent on the grading of the roadbed from this city to the Stanislaus River, 25 per cent on the delivery of the rails and ties for this portion of the road at Modesto and 25 per cent when the first car is run. While the work on the seven miles of line from this city to the Stanislaus River will be rushed to completion at once, the order for cars for the Modesto Interurban road has already gone in and the line to Empire will be run on the receipt of these cars, which, at the outside, will be within 90 days.

TRANSMISSION.

KALAMA, WASH.—The Oregon-Washington Corporation is preparing the installation of 12,000 h.p. electric plant at the old site on the Kalama river.

NEW WESTMINSTER, B. C.—The Western Canada Power Company is now surveying the Johnstone road for the construction of towers and poles for a power service.

WALLOWA, ORE.—The McCully & Rumble Company plans to build a power plant in Wallowa canyon, capable of generating 1000 horsepower. Construction work will begin about the 1st of August.

BONNERS FERRY, IDAHO.—A. H. Featherston, owner of the Bonner Water & Light Company, here, with General Manager H. A. Gale, are looking over the plant to determine the improvements to be made this year. The power plant will be enlarged.

SEATTLE, WASH.—The public utilities committee of the City Council has reported for passage the bill providing for the installation of an auxiliary power plant at the foot of Nelson place, on Lake Union, to utilize the waste waters from the Valunteer Park reservoirs.

PASCO, WASH.—E. Tapan Tannatt, consulting engineer, 516 Empire State Building, Spokane, has been engaged by this municipality to set a price for the purchase of the franchise and property holdings of the Pacific Power & Light Company, in connection with the latter's power plant, which the city proposes to purchase.

VANCOUVER, B. C.—The Howe Sound Power Company, Ltd., has applied for water rights for power purposes on Furry Creek. The application for the right to store water in connection with the power plant covers the construction of dams at the outlet of two lakes. The dams will be 30 ft. in height and will increase the area of the lakes to 122 acres.

SAN FRANCISCO, CAL.—At the last meeting of the executive committee of the Great Western Power Company the expenditure of $1,000,000 was authorized to increase the capacity of the present hydro-electric generating station at Las Plumas, on the Feather River, and to start work on a second development above Las Plumas. The company now has 55,000 h.p. installed in its hydroelectric generating station at Las Plumas, which will ultimately be doubled.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

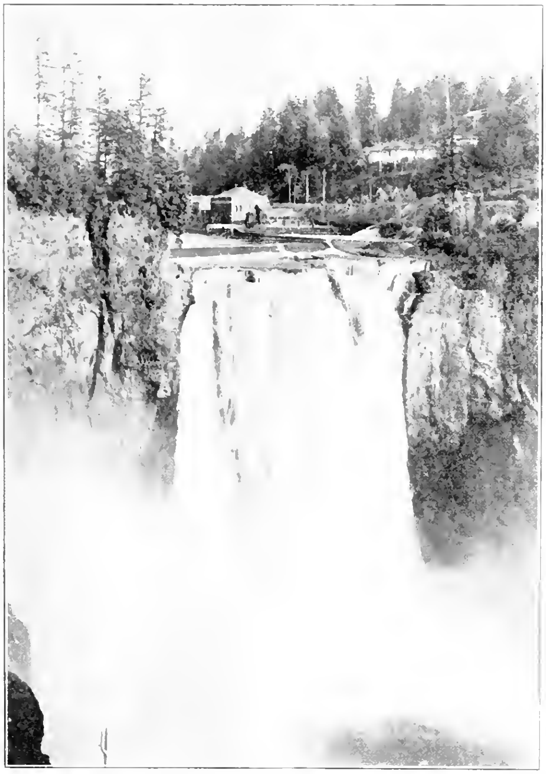
VOLUME XXVI — SAN FRANCISCO, MAY 13, 1911 — NUMBER 19

CONTINUITY OF SERVICE IN TRANSMISSION SYSTEMS[1]

BY MAGNUS T. CRAWFORD.

The object of this paper is to give the results of a number of years of operation of the Snoqualmie Falls Transmission system of the Seattle-Tacoma Power Company and to deduce therefrom practical conclusions as to the effectiveness of the method of operation used. The discussion will be confined entirely to the transmission system, and the possibilities of insuring continuous service by means of auxiliary steam plants will not be considered. Each high-tension system is a problem in itself and must be worked out with respect to its individual features and conditions, such as generating capacity in kilowatts, length of lines, size of wires, ratio of resistance and reactance, line voltage and climatic conditions. It is believed however, that a log of the operating results of a particular system is worthy of record, if the conditions of operation are correctly described.

The general features of the system are shown in the accompanying diagram and illustrations.



The Snoqualmie Falls Power Plant.

A good description of the original installation as completed in 1900 may be found in Engineering News, December 13, 1900, and the evolution of the transmission line was described in a paper read before the Seattle Section of the A.I.E.E., December 19, 1908, published in the Proceedings, and in the Journal of Electricity Power and Gas Apr. 24, 1909. The present paper covers only the four years 1907, 1908, 1909 and 1910.

Outline of System of Operation.

In the operation of high-voltage lines on the Snoqualmie system the high-voltage line switches are non-automatic electrically-operated by remote control except those used in throwing the lines in multiple at substations, which are instantaneous overload release switches. The Falls operator has on his switchboard an indicating ammeter and the control handle for an electrically-operated remote-control oil switch for each outgoing high-voltage line.

The generator oil switches are kept blocked in solid on the bus bars except when synchronizing a new machine. If the Snoqualmie system is running in parallel with the Electron system or with other generating systems as is frequently the case, the

[1] A paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Los Angeles, April 25-28, 1911.

connection is made with instantaneous overload-release circuit-breakers, and a similar connection is made with the steam plant at Seattle.

When a short circuit comes on the system all automatic circuit breakers connecting other systems and all switches for multiple connections drop out at once, leaving each line separate clear to the Falls. The Falls operator first lowers the voltage and gets the speed of the machinery under control. It is then usually apparent on the line ammeters which line is short circuited, and if it does not burn clear in a few seconds

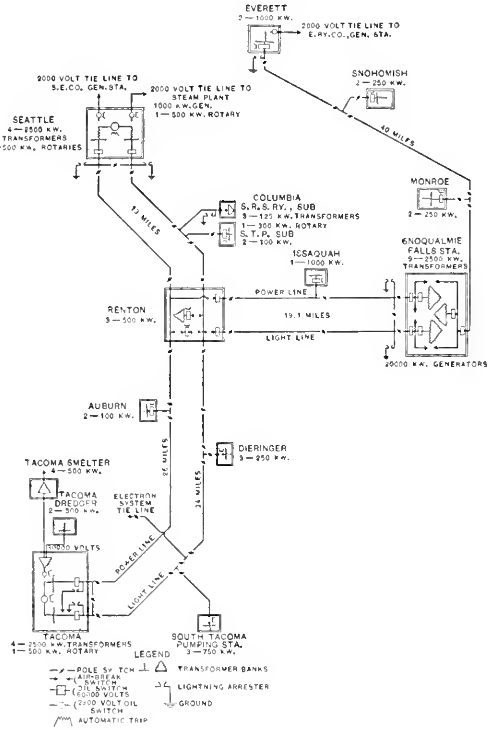


Diagram of 60,000-Volt Transmission System.

it is opened with the remote-control oil switch. The voltage is then slowly brought back to normal and only a part of the load is lost. The substation operators then open their end of their line at the pole switch, and linemen are sent out to the defective section of the line. This is located by opening all pole switches in the line and then testing out one section at a time, starting at the Falls, until a section is found which shows trouble.

If it is not apparent to the Falls operator which line is in trouble, the short circuit is fed thirty seconds, and one of the lines opened, and if it still does not clear it is fed thirty seconds longer on the other line, and the station is never shut down as long as it can be kept running. Two large water rheostats of iron wire immersed in the tailrace and provided with oil switches are thrown on the generator bus whenever a heavy load is to be dropped, as in opening a short circuited line, and serve to aid the control of speed and voltage. In extreme cases where trouble holds and all lines are

LOG OF OPERATING RESULTS.

1907.

Generator capacity 12000 kw., step-up transformers 15,000 kw. Transmission 30,000 volts three-phase, neutral ungrounded.

Poles. Cedar, average height 40 to 50 ft. (12.19 to 15.24 m.)

Spans. 135 to 160 ft. (41.14 to 48.76 m.) average length; up to 1000 ft. (304.8 m.) at river crossings.

Lines. Falls to Renton 20 miles (32.18 km.) two pole lines. Renton to Seattle 13 miles (20.92 km.), two pole lines. Renton to Tacoma 26 miles (41.84 km.) by one pole line and 34 miles (54.71 km.) by the other. Falls to Everett, 40 miles (64.37 km.) one pole line. Tacoma to Smelter at Point Defiance, 6 miles (9.65 km.) one pole line. Total 172 miles (276.8 km.)

Wires. Falls to Renton No 4/0 seven-strand aluminum. Renton to Seattle and Tacoma, No. 2/0 seven-strand aluminum. Falls to Everett, No. 4 solid copper. Tacoma to Smelter, No. 4 solid copper.

Spacing. 7 by 9 ft. (2.13 by 2.74 m.) and 7 ft. (2.13 m.) equilateral triangles.

Insulators. One piece, triple petticoat porcelain, 6 in. (15.24 cm.) diameter, Redlands pattern. White imperial porcelain on main lines. Brown porcelain on Everett line, not tested before installation.

Pins. Locust wood, impregnated with paraffine.

Cross Arms. Four by 5½ in. (10.1 by 11.13 cm.) to 5 by 6 in. (12.7 by 15.24 cm.) select Washington fir.

Switches. At Falls, non-automatic remote control, vertical break oil switches in brick compartments. At Renton, Seattle and Tacoma, non-automatic lever control, rotating horizontal break oil switches in iron tanks. At small stations and for throwing lines in multiple, fused air break "jack" switches or fused horn switches.

Protective Apparatus. Multigap lightning arresters with series resistances.

1908.

Wood pins changed to malleable iron on corners and important points.

1909.

Transmission voltage raised to 60,000 volts on December 6, 1909, using same, wires, poles and cross arms.

Insulators. Four-piece brown porcelain of standard design, each tested to 120,000 volts, and made with threaded 1½ in. (38.1 mm.) pin hole.

Pins. Malleable cast iron with threaded head.

Switches. At Falls and Renton, non-automatic remote control, vertical-break oil switches in steel tanks. At Seattle, Tacoma and Everett, non-automatic lever control rotating horizontal-break oil switches in iron tanks. At small substations, series trip coil actuated automatic overload release, rotating horizontal break oil circuit-breakers in iron tanks.

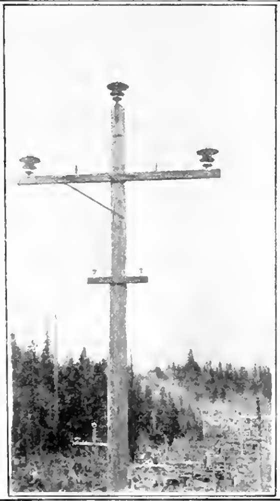
Disconnecting Switches. Out-door pole top type, three-pole double break, consisting of contact jaws mounted on line insulators with connecting blades rotating in a horizontal plane.

Protective Apparatus. Aluminum cell electrolytic lightning arresters installed at each end of each line.

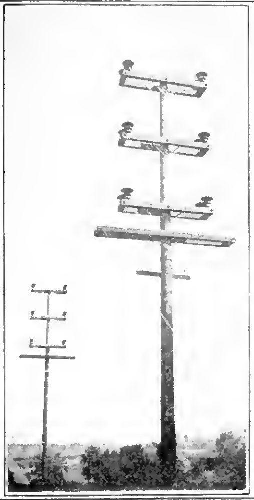
1910.

Additional 8750 kw. generator put in service in November, with 7500 kw. additional step-up transformer capacity.

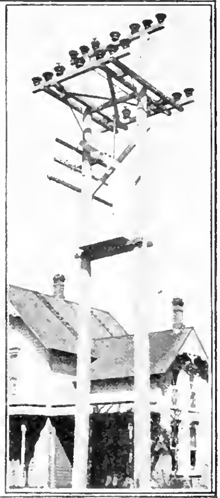
Pole-top Construction on Main Lines. (60,000 volts).



Pole-top Construction at Square Turns. (60,000 volts).



Pole-top Construction where two lines are on the same pole, showing guard wires over railroad. (60,000 volts).



Standard Pole Switch. (60,000 volts).

opened, the station is run on the water rheostats and each line thrown in again at intervals until one is found that is clear.

Substation operators open all high-tension switches when power goes off the line and immediately make connections with another generating system or steam plant, and pick up the local load until power comes on the lines again.

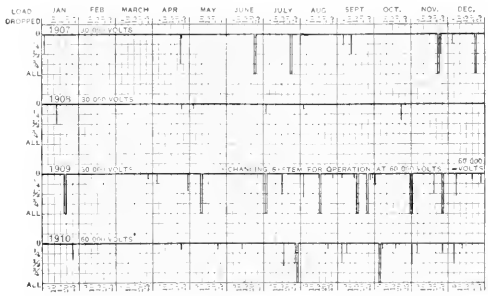
The details of the system of upkeep employed in connection with the transmission system have been carefully worked out, as a great many of the interruptions in service may be avoided by proper maintenance of the lines. Eight patrolmen are employed and each held responsible for the condition of a part of the line. They are stationed at a transforming station as near as possible to the middle of their patrol, and furnished with a residence and a telephone from the private line. Patrolmen are furnished with a saddle horse and saddle bag containing telephone test set, sundry tools and material, and once each week they carefully inspect their section of the line. All badly broken insulators are replaced and any other necessary repairs made. Every two miles along the line a small booth is fastened to a pole, and a stock of insulators, pins, cross arms, line wire, etc., are kept locked up therein, so that in case of trouble, material for repairs will always be within one mile.

Each patrolman also has charge of the pole switches in his territory and once a month he makes a complete and thorough examination of each switch, keeping the parts well oiled and in perfect alignment. Each week he makes a written report on a printed form of the results of his line patrol and switch examination.

When any repair work is to be done on a high-tension line, it is killed and opened by an air-break switch at each end, and the lineman working on the line makes a solid short circuit and ground at the point where he is working, with a flexible cable provided for the purpose. All lines are in charge of the station operator, and linemen notify the operator by telephone when a line is desired, waiting until he is told the line is dead before doing any work thereon. All communications between employees in connection with high voltage are repeated back to the speaker, and are written down in the station log book. These precautions are necessary to reduce mistakes to a minimum.

Explanation of Tables.

The following tables and curves show a log of the operation of the transmission system for the last four years. All cases of trouble on the high-tension lines or in transformers that caused an appreciable disturbance of the line voltage are recorded, but short circuits on low-tension distribution systems and other troubles not chargeable to the transmission system are excluded. The times given as "shut down" are cases where power



Service Interruptions on the Snoqualmie Transmission System.

was off the high tension lines of the Snoqualmie system long enough to switch out the defective line. The actual service interruptions were of very short duration, as power was usually obtained immediately from

TABLE I.

SERVICE INTERRUPTIONS.

Date	Extent	Load dropped	Remarks.
1907 Jan. 2 9:55 p. m.	Short voltage dip	About half	Snow on outlets at transformer house at Falls makes short circuit on power line by starting an arc. Falls operator opened power line and cleared trouble, throwing on water rheostats until load returned.
Jan. 3 1:10 a. m.	Short voltage dip	None	Short circuit on light line, burned clear. Cause unknown.
April 23 4:15 p. m.	Prolonged voltage dip	Nearly all	Telephone wires blown into high-tension wires near Seattle by high wind. Burned clear.
April 24 6:04 p. m.	Four seconds voltage dip	Small	Short circuit on system, cause unknown. Burned clear.
June 24 2:15 p. m.	Shut down	All	Solid short circuit on both lines holds until lines are opened. Cause unknown. No trouble found when lines are put in again.
July 23 8:30 p. m.	Shut down	All	Piece of iron wire thrown over both lines near Tacoma. Falls operator pulled the short circuit 30 seconds on each line before shutting down, but unable to burn clear.
August 1 7:50 p. m.	Eight seconds voltage dip	One-fourth	Arc started by lightning between wires at outlets in Seattle substation. Burned clear by lowering voltage.
Sept. 5. 1:15 p. m.	Dip in voltage	One-fourth	Severe short circuit comes on light line but is burned clear. Cause unknown.
Sept. 11 12:45 p. m.	Dip in voltage	Nearly half	Lightning storm between Renton and Tacoma. Short circuit appears on both lines but burns itself clear.
Oct. 16 10:00 a. m.	Small voltage dip	Small	Light short circuit on power line is burned clear. Caused by limb from burning tree between Auburn and Tacoma.
Nov. 22 2:45 p. m.	Shut down	All	Wooden insulator pins burned off on corner pole between Renton and Kent causing short circuit and ground on light line. Arcing ground burns up nearly two spans of wire at point of break. Surges burn up multigap lightning arresters in stations and cause pins to burn off at other points on lines where insulators were defective.
Nov. 23 5-6 p. m.	Frequent successive voltage dips	About half	Trouble develops from burned insulator pins at different points probably at places where insulators were cracked by surging ground of Nov. 22. Pole near Everett was set on fire and Everett line was out until repaired. One wire of light line in Seattle burned off cross arm and came across 13,000-volt lead of S. E. Co. As Seattle power line was cut out for repairs at other points, Seattle was out eight minutes. One transformer punctured at Seattle. Falls line also down from burned off pins near Renton but cut out before causing damage, and repairs made.
Dec. 4 3:30 p. m.	Six second dip	One-fourth	Short circuit appeared on light line and is burned clear. Low tension wires got tangled up on pole in Auburn and one of them swings up over high-tension line and is burned off. Caused by high winds.
Dec. 23 4.00 p. m.	Shut down	All	Heavy wind storm blows limb of tree into light line near Issaquah, blows down power line near Kent and light line near Auburn, all at same time. Last two places were where pins were nearly burned off. Falls operator lowered voltage and stayed in on each line separately for 60 seconds, but was unable to clear trouble. Station ran on water rheostats until troubles were located and one line repaired through.
1908 Jan. 12 5:00 p. m.	Voltage dip	About half	Short circuit on branch line to smelter in Tacoma. High-tension fuses in Tacoma substation did not open and short circuit was pulled 30 seconds by Falls operator and burned clear. Cause unknown.
April 24 3:50 a. m.	Ten seconds voltage dip	Small	Tree blown into Falls light line one-half mile (0.8 km.) from Renton. Light line opened and trouble cleared.
April 24 4.20 a. m.	Short voltage dip	Small	Everett line down near Snohomish due to defective insulators. Everett line opened and trouble cleared.
May 2 1:50 p. m.	Short voltage dip	Small	Defective insulators on line to Tacoma lets wires down on cross arm. Cross arm burned off, clearing trouble.
July 2 3:15 p. m.	Ten seconds voltage dip	One-fourth	Short circuit and ground on power line due to defective pole switch at Seattle. Seattle operator knew location of trouble and cleared it by opening high-tension line oil switch.
August 3 9:45 p. m.	Short voltage dip	Small	500-kw. transformer burned out at Lewis & Wiley's pumping station. Cleared by high-tension fuse in substation.
Oct. 22 4:32 a. m.	Voltage dip	Nearly half	Short circuit on line to dredger in Tacoma harbor cleared by high-tension fuse. Caused by salt water fog where line runs about 30 ft. (9.14 m.) from surface of water, and spacing between wires only 3½ ft. (8.9 cm.)
1909 Jan. 3 8.10 p. m.	Short voltage dip	Small	Short circuit on Tacoma dredger line. Cleared by high-tension fuses. Caused by salt fog.
Jan. 19 2:30 p. m.	Shut down	All	Line to Tacoma smelter was connected to both light and power lines at Tacoma substation when a land slide carried away several spans. Falls operator lowered voltage and kept each line in 30 seconds before opening.
March 26 5:00 a. m.	Short voltage dip	Small	500-kw. transformer burned out at Lewis & Wiley's pumping plant. Cleared by high-tension fuse in substation.
April 4 8.45 p. m.	Long voltage dip	One-fourth	Severe short circuit on Tacoma dredger line holds until voltage is lowered. Probably from salt fog.
April 29 8:20 a. m.	Voltage dip	Nearly half	Transformer burned out and grounded on Tacoma smelter line. Discharges lightning arresters in Seattle and Tacoma substations.
May 10 11:25 a. m	Shut down	All	Burning tree falls into Tacoma power line near Auburn, breaking down four spans of line, causing arcing ground that results in puncture of No. 1 generator armature. Lines opened until defective generator could be cut out and load picked up on rest of station.
July 2 5 15 p. m	Shut down	All	While Tacoma power line was cut out for work thereon, light line was connected to both Falls lines and a tree was blown into the light line near Auburn, making a short circuit and ground which would not burn clear. Both lines had to be opened until defective line could be switched out at Renton.
July 3 12 35 a. m.	Heavy voltage dip	Small	Short circuit on power line burned clear. Linemen repairing break of July 2d on a dark night left telephone wire across line, and when line is switched in at Renton telephone wire is fused.
July 15 10 30 a. m.	Voltage dip	Half	Short circuit on light line near Seattle, cause unknown. Light line opened, clearing trouble.
August 2 12:15 p. m.	Sixty seconds voltage dip	Over half	Falls line cut out for linemen to work on about 3 miles (4.8 km.) from Renton. A solid short circuit and ground put on wires where they were working with a piece of ¼-in. (6.35 mm.) steel mast arm rope, as a safety precaution. By mistake line was reported clear and switched in at Renton end with short circuit still on and Renton multiple switch closed solid. Falls operator lowered voltage and pulled the short circuit by way of light line and Renton multiple switch. In about 60 seconds the ¼-in. (6.35 mm.) steel rope was fused clear of the line, and water rheostats were thrown on generator bus.
August 16 5:20 p. m.	Shut down	All	Steam shovel gets into line at Seattle, letting down two spans and causing arcing ground and short circuit that punctures two transformers and No. 5 generator at Falls. Station shut down until defective apparatus could be cut out.

Date	Extent	Load dropped	Remarks.
August 26 2:50 p. m.	Short voltage dip	Small	Short circuit in 500-kw. transformer at Lewis & Wiley's pumping plant. Cleared by high-tension fuse in substation.
Sept. 4 2:35 p. m.	Voltage dip	Everett only	Short circuit on Everett line, cause unknown. Cleared by high-tension fuse on Everett line.
Sept. 13 12:15 p. m.	Voltage dip	Everett only	Short circuit on Everett line caused by blasting stump into line. Cleared by fuses on Everett line.
Sept. 16 3:20 p. m.	Shut down	All	Seattle light line short circuit and grounded by blasting stumps near Seattle. Arcing ground punctures No. 3 generator armature and station is shut down.
Sept. 24 7:00 p. m.	Shut down	All	Pile driver knocks down long span in Everett line across Snohomish River. Fuses blow on Everett line and start arc across wires, short circuiting high tension bus in transformer house at Falls; station shut down until bus could be cleared.
Sept. 26 7:12 p. m.	Voltage dip	Everett only	Short circuit on Everett line cleared by fuses. Pile driver strikes line at Snohomish.
Sept. 27 2:40 p. m.	Voltage dip	Small	Pole switch at Puyallup does not close properly and starts arc across wires when opened. Burned clear by lowering voltage.
Sept. 30 8:05 p. m.	Heavy voltage dip	One-fourth	800-kw. transformer burned out at South Tacoma pumping station. Cleared by fuses in substation.
Oct. 31 10:35 a. m.	Shut down	All	Light line cut out for work thereon when power line was torn down by blasting stumps near Kent. Falls operator was unable to burn the trouble off and cut both lines out until Renton switched clear of the trouble.
Nov. 18 1:30 p. m.	No shut down of system	Half	Floods and high winds washed out 12 poles carrying both light and power lines near Tacoma, and they were blown over. Trouble reported and lines opened before they went down. Wires not broken and poles were pulled up clear of the ground and lines cut in.
Nov. 25 9:00 a.m.	Shut down	All	Flood washes out Everett line near Snohomish. Wires and switching in temporary condition at Falls during change to 60,000 volts, and unable to clear without shut down.
Dec. 5.			SYSTEM CHANGED FROM 30,000 TO 60,000 VOLTS WITHOUT INTERRUPTION IN SERVICE.
Dec. 6 10:28 p. m.	Heavy voltage dip	Over half	Limb of tree blown into light line 2½ miles (4 km.) from Falls breaking wires and causing short circuit and arcing ground. Electrolytic lighting arresters discharged taking heavy surges off of line. Light line opened by operator clearing trouble; water rheostats thrown on until load returned.
Dec. 20 10:15 a. m.	Voltage dip	Small	Pole switch arced across at Renton when opening Tacoma light line. Switch closed again and dip of voltage breaks arc.
Dec. 27 3:10 p. m.	Heavy voltage dip	One-fourth	Short circuit on Everett line cleared by opening line switch at Falls. Caused by blasting stump into line a few miles from the Falls, breaking wires.
Jan. 25 8:07 p. m.	Voltage dip	Nearly half	Severe short circuit cleared by opening light line. Multiple switches at Seattle and Tacoma drop out. Trouble caused by high wind blowing over a corner pole near Kent, the line falling into a lead of telephone wires. Telephone system damaged but slightly.
April 16 12:25 p. m.	Slight voltage dip and swinging of ground detector	None	Ground appears on system but burns clear in a few seconds. Caused by blasting stumps 300 ft. (91.44 m.) from line near Milton. Large rock breaks one wire of line and it falls to ground burning off clear at Falls end. Trouble located and line cut out and repaired.
April 24 9:05 a. m.	Voltage dip	Small	Pole switch on Tacoma light line arced across at Renton when opening charging current of line with blades set too close. Cleared by opening light line at Falls.
May 23 8:15 p. m.	Voltage dip	Small	Light short circuit burns clear at once. Tree fell across light line near Renton but did not break wires. Renton operator notified of trouble and opens line at Renton.
June 12 11:35 p. m.	Slight voltage dip	Small	Surge appears on light line and ground detector, clearing immediately. Transformers at South Tacoma pumping station burned out. Trouble cleared by high-tension fuse in substation. This substation owned and operated by consumer.
July 16 9:15 a. m.	Prolonged voltage dip	Over half	Pole switch at Renton arced across when opening charging current of line, with blades set too close. Short circuit appears on both lines and Falls operator opened light line. As this did not clear trouble light line was closed again and power line opened clearing trouble.
July 26 8:10 a. m.	Heavy voltage dip	Half	Short circuit appears on Everett line and is burned clear. Cause unknown.
July 26 9:45 a. m.	Shut down	All	Tree blew across Everett line breaking wires down. Remote control handles for line switches were in a temporary location at one side of switchboard while some new panels were being put into position. Operator made mistake in switchiing and had to open all lines and throw on rheostats until generators could be controlled
August 22 1:35 p. m.	Slight voltage dip	Small	Ground appears on light line, discharging electrolytic lightning arresters Burns itself clear. Cause unknown.
August 26 6:35 p. m.	Slight voltage dip	None	Ground develops and clears itself. Cause unknown.
Sept. 3 11:15	Voltage dip	Half	Telephone wires pulled across power line in Seattle by careless lineman. Power line opened by operator and trouble cleared. Half of load dropped as Tacoma was running on power line with light line cut out temporarily.
Sept. 7 11:05 a. m.	Voltage dip	One fourth	Short circuit on Everett line from unknown cause. Trouble clears when Everett line is cleared.
Oct. 4 11:25 p. m.	Shut down	All	Corner pole cut down with an axe near Tacoma, both light and power lines falling across county road and telephone lead. Falls operator unable to burn clear and both lines left out until defective section could be opened. Telephone Company's system not damaged severely.
Oct. 5 11:15 a. m.	Voltage dip	Small	Short circuit on light line burns itself clear. Cause unknown.
Oct. 17 3:15 a. m.	Voltage dip	Small	Short circuit cleared by opening Everett line. Stump blasted into line by contractor building new railroad near line.
Oct. 30 11:03 a. m.	Heavy voltage dip	Over half	Short circuit appears on both lines but burns itself clear. Cause unknown.
Nov. 4 5:40 p. m.	Two successive voltage dips	One-fourth	Stump blasted into Everett line. Trouble burned clear.
Nov. 25 8:05 p. m.	Voltage dip	One-fourth	Short circuit appears and is burned clear in a few seconds. Caused by blasting piece of stump into Everett line.
Dec. 5 7:00 p. m.	Three severe voltage dips	Half	Malicious persons throw piece of half-inch (14.7 mm.) steel cable over both light and power lines about three miles (4.82 km.) from Renton on Seattle lines. Steel cable was burned in two and trouble cleared on power line although line wires were badly scarred. On light line one line wire was burned in two, fell to ground and burned off clear of ground on Falls side. Falls operator did not open any lines, as short circuit appeared the same on each and was burned clear
Dec. 11 12:15 a. m.	Voltage dip	Small	Defective insulator on pole switch at Seattle punctures and starts arc to ground. Electrolytic lightning arresters flash over, taking surge to ground and trouble burns itself clear.

another system or steam plant at Seattle, Tacoma and Everett.

The conditions of transmission are somewhat severe, as the lines pass through rough country and along country roads. The land is being cleared for agricultural purposes and for new railroads, so that a great deal of blasting and grading is being carried on, causing much trouble. The pole line has been built ten years, and has not the mechanical factor of safety of a new line. The tables show how the troubles resulting from these adverse conditions were handled with a minimum disturbance to service, as out of the total of 66 cases of trouble given in the table, 52, or about 80 per cent, were handled without an interruption of service.

During the latter part of 1907 considerable trouble was caused by burned wooden pins. These pins had been in service nearly seven years, and the threaded tops were softened to pulp, apparently by the action of nitric acid formed from the air and moisture by the leakage currents.

TABLE II.

SUMMARY OF SERVICE INTERRUPTIONS 1907-8-9-10.

		Voltage dips.		
	Shut downs	Dropping Half load	Dropping Quarter load	Total cases
1. Defective line construction, failure of switches, insulators, etc.	1	2	7	10
2. Failure in transformers.........	0	1	5	6
3. Malicious interference, blasting stumps, etc.....................	6	1	7	14
4. Winds, fires, floods, fogs, etc....	6	6	6	18
5. Lightning	0	1	1	2
6. Mistakes by employees.........	0	2	1	3
7. Unknown	1	4	8	13
Totals	14	17	35	66

Note.—Of the fourteen cases of shut down, seven occurred during the half of 1909 when the system was running on one line during working hours to permit reconstruction for 60,000 volts. During the other $3\frac{1}{2}$ years the average was two cases of shut down per year.

The line was gone over by patrolmen and on all turns and important places the wood pins were replaced by malleable iron pins, and no more trouble resulted from this cause With the weak points thus fixed the system gave practically continuous service during the year 1908. During 1909 the work of re-construction for 60,000 volts was in progress and nearly half of the system was cut out during working hours for work thereon, and the switching was in a temporary condition at many places. These circumstances made it difficult to handle trouble without interruption of service. During the year since the change to 60,000 volts there have been only two shut-downs out of 23 cases of trouble, showing the method of operation is equally successful at the increased voltage.

The duplicate high voltage lines are known by the names light and power lines respectively, and are divided into sections known by the names of the principal stations toward which they lead from the junction point at Renton.

Discussion of Results.

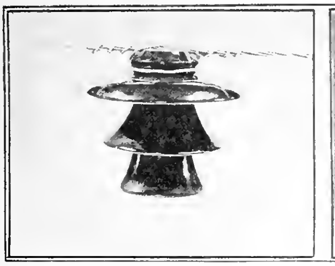
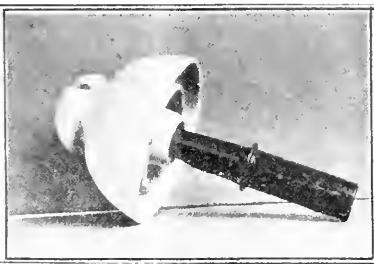
Before discussing the above results, a definition of continuous service is necessary. In cases where only a voltage dip is shown, the bus voltage of 115 volts dipped down to some value between 40 and 90 volts for a few seconds and then returned to normal. To the lighting consumer this is not objectionable if it does not occur too frequently. To the small power consumer, such as shops and industries using motors in small units, generally speaking it is not a serious inconvenience, as the motors will often come back up to speed and will at most only require restarting. In the case of very large power units, they will usually stay in on the line unless they are heavily loaded or the dip is too prolonged.

The 500-kw. synchronous converters on the system almost always stay in and are not cut off until the current goes clear off the line. On the other hand if the voltage dip is very sudden in its return to normal, as where a short circuit is opened at its maximum and a Tirrill regulator has held up the generator voltage, large synchronous machines are much more apt to be thrown out. In the above table there are 52 cases where the voltage dipped but the system was not shut down, and in only 17 of these cases was the dip sufficiently prolonged to lose any considerable amount of load. In the other cases practically all the large motors stayed on the line. It seems reasonable then to conclude that moderate voltage dips of short duration do not constitute an interruption worth considering.

In cases where the voltage gets to a very low value and does not return to normal for ten seconds or more, the most of the power load will be dropped, but the lighting load will be retained. The power consumer is then put to the inconvenience of stopping work long enough to start up his motors again. The railway station operator must synchronize his converting units again, but if the drop is not over thirty seconds they should still have considerable speed and this should only be a few minutes work, which is not a hardship to railway service. Some power installations will suffer great inconvenience, such as for instance an ammonia compressing outfit, and also some electrolytic processes, where even a momentary shut down will cause heavy loss. However, such consumers will only form a small percentage of the average power company's business, and any expensive equipment to insure them absolutely continuous service should be a part of their own installation.

In cases where power goes completely off, all load is dropped and all consumers suffer maximum of inconvenience until service is resumed. The gross income of the power company practically ceases and the operating expenses continue, besides the loss in good will which can not be measured. If service is resumed within five minutes, the average consumer will not suffer serious loss, but where the shut down extends over thirty minutes or an hour the financial loss and inconvenience is very considerable to all parties concerned. We may then conclude that prolonged voltage dips are an inconvenience but if of infrequent occurrence are not serious menaces to satisfactory service, whereas complete shut-downs cause heavy loss. Speaking from the average consumers viewpoint, commercially continuous service may include infrequent voltage dips and very rare shut-downs of periods never exceeding five minutes.

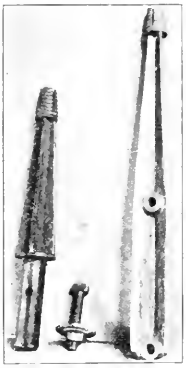
Causes of Troubles. The first two causes in Table II are defective construction and apparatus, and burnouts of machinery. By testing all line insulators for a voltage a little over twice normal and carefully testing all machinery winding before installation the entire system may be made to withstand double normal volt-


Center View Shows Porcelain Insulator and Iron Pin for 30,000 Volt Line. Pictures on either side show type of tie and 60,000 Volt Insulator, 1 0 Seven-Strand Aluminum Cable With No. 2 Tie Wire.

age for several minutes without failure of insulation. This means that transient voltages considerably in excess of double normal voltage can be withstood, as brought out by Steinmetz and Hayden in a paper before the A.I.E.E. in June, 1910. By installing protective apparatus such as air relief gaps which are set to break down at double voltage and which have a time lag much lower than that of the insulation of the system, practically all destructive surges can be taken off the system. This may be done by installing electrolytic lightning arresters at the entrance to all important stations. If lightning becomes so troublesome as to shatter insulators on the line where it strikes at some distance from an arrester, relief gaps may be installed at each insulator if necessary, by means of arcing rings as described by Nicholson in a paper before the A.I.E.E., March 30, 1910. In this plant, however, lightning strokes on the line are very rare, and by using wood poles and cross arms, an entire pole may be burned down without interrupting service if the wires are not broken. The first two causes of trouble and also the sixth can thus be reduced to a minimum by properly testing the insulation of apparatus and the installation of protective apparatus.

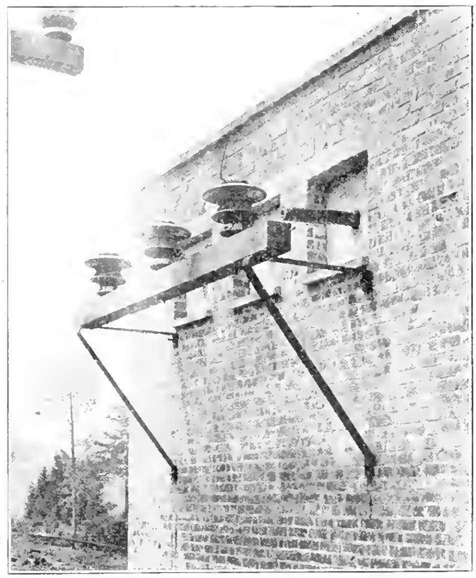
30,000-Volt Entrance Construction.



Malleable cast iron pins. Cross-arm pin fits $1\frac{1}{2}$-in. hole in old cross-arms. T-headed bolt slips into a seat on a shoulder cast on inside of shank at bottom, and is tightened up under cross-arm. Weights $3\frac{3}{4}$ and 7 lb. Ultimate strength 1800 lb. at line wire. (60,000 volts).

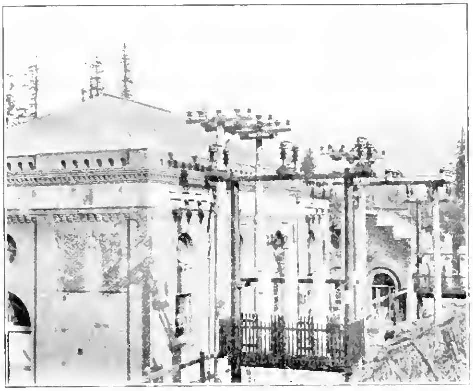
Blasting stumps is a source of much annoyance in this section of the country, and can best be handled by a campaign of publicity. The patrolman on each section of the line should make it his business to become personally acquainted with all the ranchers enroute and keep his eye open for all evidences of preparation for clearing land, and when he sees blasting is to be done call attention to the notices of warning kept on each pole, and show every desire to cooperate with the parties concerned and have the line killed before blasting is done. Deliberate interference should be prosecuted vigorously by arrest and fine where possible.

Troubles from winds, fires, floods, etc., can be mitigated by using a very large factor of safety in the mechanical construction of the line, and by putting the high tension wires at a good height above all telephone and other wires easily broken. Structures in soft soil should be set solidly in rock boxes and well braced, lines taken via separate routes whenever possible, and always on separate pole lines. All large trees that can blow into the line should be bought and cut down, and the brush kept closely cut on the right of way.



Entrance Tubes at Substations (60,000 volts).

Mistakes of employees can be reduced by providing them with definite written instructions on their duties and course of action under various conditions and by providing them with the best working equipment. Station operators in a plant employing non-automatic operation are very important units in the system; a little welfare work and good pay to good men, and in fact anything that will make them take interest in their work and pride in good results will prove an excellent investment.



Switching and Lightning Arresters at Snoqualmie Falls.

Results of Method of Operation. The standard practice in the operation of duplicate transmission lines is to install automatic overload relays and circuit breakers on each line at the generating station, and reverse current relays with automatic circuit breakers at the substation. Even with complicated systems this idea may be carried out so that theoretically a short circuit anywhere on the system will automatically be cleared and the defective line cut out. The experience of this company has been that practically better results can be obtained by placing the control of the high-tension lines in the hands of a carefully trained operator. From the operation of this system it is believed that the non-automatic method of operation is less apt to produce destructive oscillations when a short circuit is being cleared from the system. Taking for instance a case where a piece of iron wire is thrown across the line. There being no automatic regulation except slowly acting water wheel governors, the speed and voltage of the generating units dip severely. The operator encourages this and blocks the action of the governors, feeding the short circuit at the reduced voltage. The low-frequency high-power surge first set up by the short circuit may thus be reduced in intensity, being also dissipated by the resistance and cushioned by the reactance of the line, and the station is then simply running on a severe overload for a few seconds. If it is apparent which line is short circuited, it may then be opened with safety. If on the other hand the voltage and speed are automatically held up as far as possible by Tirrill regulators and governors, and the surge is ruptured at a point other than zero in the wave, a destructive potential will result which may cause damage.

In the case of an arcing ground a more severe condition exists than in a short circuit, as in cases where one line wire is whipping around on the ground, making and breaking contact. In this system where the neutral is ungrounded severely unbalanced strains may be produced in this way, as is shown by the puncturing of generator and transformer windings in such cases. An arcing ground was not always visible on the line ammeter, and an electrostatic ground detector was installed on the generating bus. This indicates promptly all high-tension grounds, and the telephone circuit along the same poles is an instantaneous indicator showing which line is grounded. Grounded lines are cut out without attempting to burn clear, and the installation of electrolytic arresters on the lines, transformers with reinforced insulation on the end coils and static relief gaps on the generating bus bars has given entire freedom from trouble from arcing grounds, as shown by the absence of failures of insulation since the installation of the new equipment in 1909.

Since the change to 60,000 volts it has been the practice to open the defective line if it does not burn clear in about five to eight seconds instead of holding for thirty seconds. By the installation of a Tirrill regulator with a special relay for lowering the voltage during a short circuit the operator does not have to look after the voltage, and with accurately reading dead-beat line ammeters he is able to see the situation inside of five seconds. This equipment has been recently installed. The switches for multiple connections now installed on the low-tension side at substations work instantly instead of in the slow uncertain manner of the old 30,000-volt fuses used for this purpose, so that much better performance can be expected in handling short circuits in the future.

This method of operation is applicable to a system of several generating stations, by giving each generating station a certain amount of transmission system, and then using instantaneous automatic circuit breakers at the point of connection. These circuit breakers can be set to carry the full value of interchange current so that the plants can be operated in parallel and with any desired sharing of load; but when a short circuit comes on the line, that line and its generating station will immediately be separated from the rest of the system and can clear its own trouble. Mr. Downing's paper before the San Francisco meeting in May, 1910, on the "High Tension Network of a General Power System" describes a system operated in this way.

It is apparent from this paper that there are a number of features which an engineer could employ in building a new line that would prevent many interruptions, such as stringing the lines at a greater height and supporting them on strong structures along private right-of-way, to avoid interference. The desirability of continuous service depends on the character of the power business served, and a balance may be struck at a point where further investment to secure greater reliability may not be warranted.

Eectroly'ic iron of great purity can be obtained from mild steel anodes. It requires 1 kw.-hour to refine 2 lb. of iron and the cost of labor, maintenance and fixed charges has been estimated at $10 per ton of iron produced.

WASHINGTON PUBLIC SERVICE COMMISSION.

The newly created Public Service Commission in the State of Washington consists of three members appointed by the Governor with the consent of the Senate, for six-year terms. Each commissioner is to receive a salary of $5000 a year. A secretary to receive $2000 a year salary is to be appointed by the commission. Other officers of the commission are to be a rate clerk and statistician at not more than $3000 a year, an engineer at not more than $3000 a year, an inspector of safety appliances at not more than $3000 a year, an expert accountant at not more than $1800 a year, a stenographer at not more than $1800 a year, and such engineers, inspectors, accountants and other assistants as the commission may deem necessary. The commission is to have jurisdiction over all public service companies in the State.

The commission is authorized to fix rates, fares or charges, and where rates, fares or charges are insufficient to yield reasonable compensation the commission is empowered to determine the charges and to fix the same by order. It is also given power to fix joint rates and through routes on railroads. Every public service company is to notify the commission of every accident which results in death or injury to any person. The commission is authorized to investigate all accidents and to order repairs or changes in railroad property wherever it deems changes or repairs necessary. It may even compel the suspension of traffic until repairs are made.

Copies of all complaints are to be served upon the companies affected and not less than ten days are to intervene between the date of service of the complaint and the hearing. All orders and findings rendered by the commission are to become operative twenty days after service, unless the commission deems that additional time is reasonably necessary to comply with the order. Every company that violates an order of the commission is liable to a fine of $1000 a day for each offense and every officer or employe of a company who violates an order of the commission is to be deemed guilty of a gross misdemeanor.

Appeal for a writ to review the finding of the commission may be made to the Superior Court of the county in which the proceeding was instituted within thirty days of the date of the order of the commission, and the court is empowered to restrain the commission from enforcing its order pending the determination of the suit. Appeal from the finding of the Superior Court may be made to the Supreme Court of the State. The transcript of the proceedings before the Superior Court is to constitute the record on appeal to the Supreme Court.

When complaint has been made to the commission concerning the reasonableness of any rate or charge and the commission has determined that the charge is excessive, the commission may order the company to pay to the complainant the amount of the overcharge with interest from the date of collection. If the overcharge is not paid within the time fixed in the order, suit may be instituted to recover same, and the findings and order of the commission are to be prima facie evidence of the facts therein stated. "All complaints concerning over-charges shall be filed with the commission within two years from the time the cause of action accrues, and the petition for the enforcement of the order shall be filed in the court within one year from the date of the order of the commission."

The commission is authorized to inspect the books and other documents of any public service company and to examine under oath any employe. Every company is to report annually to the commission and answer specifically all questions propounded by the commission. The annual reports are to include the amount of capital stock issued, the dividends paid, the surplus fund, if any, the number of stockholders, the funded and floating debts and the interest paid thereon, the cost and value of the company's property, details of franchises and equipment, the number of employes and the salaries paid each class, the accidents to passengers, employes and other persons, the cost of the accidents, the amounts expended for improvements and such information in relation to rates, charges and contracts as the commission may require. The commission is also empowered to require any public service company to file a monthly report of receipts and expenses.

In regard to the valuation of the property of the public service corporations the measure says in part:

"The commission shall ascertain the cost of construction and equipment and the cost of reproducing in its present condition the property of every public service company; the amount and present market value of the capital stock and funded indebtedness of every company; in the case of companies engaged in interstate business, the relative value of the use to which such property in this State is actually put in the conduct of interstate business and State business respectively; the total market value of the property of each company; the time intervening between the expenditure of money in the cost of construction and the time when returns in the shape of dividends were first received; the probable earning capacity of each company under the rates now charged and the sum required to meet fixed charges and operating expenses, and in case of a company doing interstate business the probable earning capacity of intrastate business and the sum required to meet fixed charges and operating expenses on intrastate business, and the relative proportion of intrastate and interstate business, the relative proportion of the operating expenses connected therewith, the relative proportion of the revenue which should be derived therefrom; the density of traffic and of population tributary to every company; the existence of grades, curvatures and other physical conditions affecting the movement of traffic and business of common carriers, and whether the expenditures made in procuring property were justified by the existing conditions, and whether the money expended has been reasonable for the present needs of the company, and for such needs as may reasonably be expected in the immediate future."

The sum of $118,146.68, or such sum as may be necessary, is appropriated to carry out the provisions of the act.

AN ELECTRIC FURNACE FOR ZINC SMELTING.[1]

BY FRANCIS A. J. FITZ GERALD.

There is no branch of metallurgy which is apparently more suited to electric furnace treatment than that of zinc smelting. The regular method of zinc smelting is extraordinary in its crudity, inefficiency and expense, hence the relatively high cost of heat generated electrically is not by any means so serious a consideration as in certain other metallurgical processes. Moreover the electric furnace possesses certain characteristics which make it specially applicable to the conditions of zinc smelting. In the following paper it is proposed to describe briefly a new form of electric furnace originally designed for zinc smelting, although it has useful applications in other kinds of work.

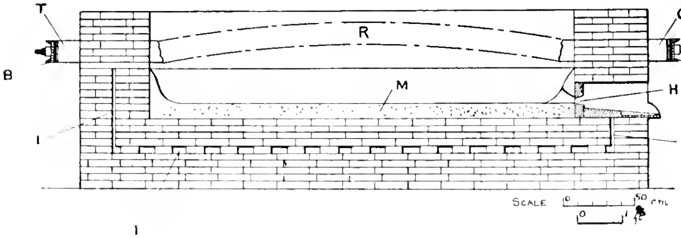


Fig. 2.

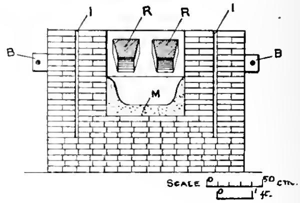


Fig. 1.

It is not intended to discuss here the metallurgy of zinc smelting, but to appreciate properly the electric furnace which will be described it will be necessary first briefly to consider the particular method of zinc production for which the furnace was designed. It has long been known that when zinc sulphide and metallic iron are strongly heated the following reaction takes place:

$$ZnS + Fe = Zn + FeS$$

but the reaction does not seem to be complete unless there is a relatively large excess of iron, or unless the temperature of the reaction is very high. Imbert, however, discovered that by using suitable "dissolvents" this objection to the process is overcome. Imbert, for example, found that ferric oxide and iron sulphide mixed together in the proportion of one part and three parts respectively formed a fluid bath at a temperature between 1000 degrees and 1100 degrees Centigrade, and that this bath would "dissolve" six parts of blende. Now when the blende is "dissolved" in a bath in this way the reaction with iron mentioned above takes place with the greatest ease, is complete, works at a comparatively low temperature and as a residue produces two distinct substances — A slag consisting of the gangue from the ore and a ferrous matte which may be used for the regeneration of iron, etc.

A great many experiments were made with this process and the results were highly satisfactory, except that it was difficult to construct a suitable furnace for the purpose. Obviously working the process in the ordinary zinc retort furnace would not be satisfactory, for the process should be carried out with a much larger unit than a zinc retort. When it comes to applying fuel heat to such a process numerous difficulties arise which are sufficiently plain without mentioning them in detail. This naturally led to the idea of using an electric furnace and many experiments with various kinds were made. Finally Mr. John Thomson and the author designed a furnace which was used on a large scale in the working of the Imbert Process. One of these furnaces of 150 kilowatt capacity was constructed and worked under the author's supervision in Hohenlohehutte, Upper Silesia, with highly satisfactory results.

In order to design a satisfactory furnace it was necessary to keep certain points in view: The furnace must be gas tight; the temperature must admit of careful regulation; the construction must be rugged so as to stand severe usage; the heat losses must be reduced to a minimum since electrically generated heat is always expensive.

In Figs. 1 and 2 are shown respectively a longitudinal section and transverse section of the furnace with the cover removed. The walls of the furnace are double with air-spaces I which are designed to prevent the loss of heat by conduction through the walls. The furnace is provided with carbons T, T, C and C. The two former serving as terminals which are connected to the source of current by means of cable indicated by F and G, while the two latter are simply connector terminals which form the other terminals of the two sections of the resister R, R, and are connected by E. Bearing on the terminals T, T and the connector terminals C, C, are channels B, B which are connected with each other by the tensions rods S, S. The channels are, of course, insulated from the terminals. The furnace is lined with a suitable refractory M and is provided with a tap-hole at H. The resistor of the furnace is built up of a series of corrugated plates, which are illustrated in Fig. 3; the lower photograph showing an end view of the plate, while the above shows the shape in which the plates are cut as viewed from the front. In Fig. 4 is shown a view of the plates set up so as to form a resistor. Considering one of the plates it is to be noted that the thickness is not the same from top to bottom, but increases from the bottom up so that when put in place they form an arch of very long radius as shown in Fig. 4. Because of the interlocking of the plates this arch form is not necessary, but seems to be desirable in the preliminary assemblage and is also utilized to produce a somewhat greater current density along the lower surface of the resistor. The cover of the furnace, which is not shown

[1]Presented before the Congress of Technology at the Fiftieth Anniversary of the Granting of the Charter of the Massachusetts Institute of Technology.

in the illustration, carries feeding tubes by means of which the ore mixture may be fed into the bath below the resistor.

The peculiar construction of the resistor plates has two purposes; to give a sufficiently high resistance to the resistor and at the same time to form an interlocking device so that even if no arch form is given to the resistor yet it will not fall down. A furnace was built with plates having these dimensions: Length at top, 405 mm. 16 inches; length at bottom, 255 mm. 10 in.; width 165 mm. 6.5 inches. The two sections of the resistor contained 71 plates each. This when cold had a resistance of 0.200 ohm and when running at the full capacity of 150 kilowatts, and with a temperature in the furnace of 1400 degrees C., the resistance was 0.0375 ohm. This resistance is due almost altogether to the contact resistance between the plates, for by calculating the resistance of the carbon itself we find that it would not amount to more than 0.00064 ohm.

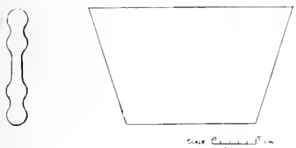


Fig. 3.

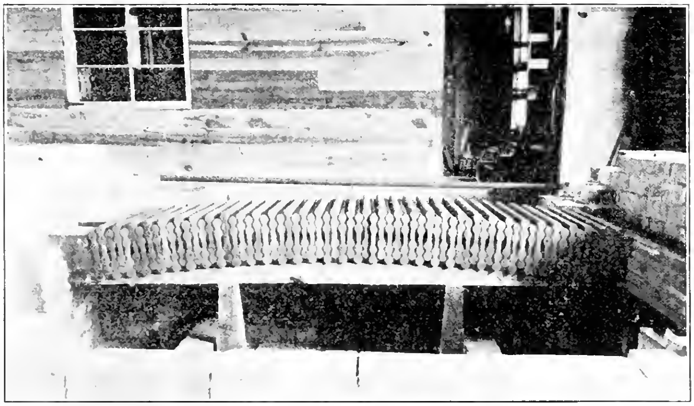


Fig. 4.

In order to regulate the rate of generation of energy in the resistor there must be some means of varying the voltage at the terminals of the furnace. At Hohenlohehutte, as well as in the FitzGerald and Bennie Laboratories where these furnaces have been worked, this is done by means of a transformer with several taps brought out from the primary coils which allow the voltage on the secondary circuit to be varied from 50 to 100 volts in 2.5 volt stops, and from 100 to 200 volts in 5 volt stops.

It will be seen that the weakest part in this furnace is the carbon resistor, due to the fact that if working in an oxidizing atmosphere the resistor will be destroyed. In the particular work for which it was designed, however, there would be no danger of this because the furnace is filled with vapor of metallic zinc. During the process of heating the furnace, or at any time when zinc vapors were not generated, there would be danger of burning through air leaking in; but this is easily overcome by keeping a reducing atmosphere in the furnace slightly above external pressure. It has been found by actual experiment that a furnace of this type running continuously for two months showed no appreciable wear of the resistor.

The regulation of temperature in this furnace is most satisfactory. In the Hohenlohehutte experiments thermo couples of pyrometers were placed in several parts of the furnace to study the temperature conditions carefully. It was found that the most accurate regulation of the temperature in the furnace was possible, the workman in charge adjusting the rate of generation of energy in the resistor so as to keep the needle of the pyrometer stationary.

The furnace is a highly efficient one. In one of the earlier models where the heat insulation was far from being satisfactory careful determinations of all heat losses were made. When working at temperatures between 1250 degress and 1260 degrees C. the total heat losses were 33 kilowatts, and when working at temperatures between 1400 degrees and 1450 degrees C. the heat losses were 42 kilowatts. Consequently when the furnace is working at full capacity, 150 kilowatts, the thermal efficiency at 1250 degrees is 78 per cent and at 1425 degrees C. is 72 per cent. No exact determinations of the efficiency of later models have been made, but it is known to be much higher than those given above.

The metallurgical end of the problem has not been completely worked out, but the satisfactory working of the furnace has been clearly demonstrated, and furnaces built on similar principles have been used experimentally with great success in the melting of aluminum, copper, brass, etc. This is thought to be of some interest, as a development in the use of electric furnaces using the heat generated by the passage of an electric current through a resistor. There is a tendency in electric furnace work to employ the arc which is often a mistake because of the difficulty in regulating the temperature. Finally, the furnace described above from its construction lends itself readily to adaptations which permit of using the combined heat effects of fuel and electricity, and it is thought that a great future is in store for furnaces of that type.

Electrical heating of water requires 110 watts to raise 1 quart from 60 to 220 degrees F., the boiling point. Immersion heaters have an efficiency of about 90 per cent.

ESSENTIAL FACTORS IN THE FORMATION OF PRODUCER GAS.

"Essential Factors in the Formation of Producer Gas" is the title of Bulletin No. 7, just issued by the Bureau of Mines. The authors, J. K. Clement, L. H. Adams, and C. N. Haskins detail an investigation of the chemical and physical processes that take place in the gas-producer in which they kept in view not only the possibility of increasing the efficiency of the producer as a source of energy and the ensuing benefits to the public of cheaper power and greater utilization of low grade fuels, but also the application of the results to the problems of boiler-furnace operations.

In experiments made by one of the authors at the Bureau's Experiment Station it was found that the temperature in the fuel bed of the gas-producer varied greatly in different parts of the bed. In order to ascertain the conditions of temperature most favorable to the efficient operation of the producer, it became necessary to determine the temperature required for the formation of carbon monoxide and hydrogen.

Among other reasons for investigating the conditions for the reduction of carbon dioxide by carbon was that a small quantity of carbon monoxide is invariably contained in the flue gases of boiler furnaces and it was hoped that means might be suggested of preventing its formation and the resulting loss in furnace efficiency.

These investigations demonstrated that a very high temperature is necessary for the production of carbon monoxide from carbon dioxide and carbon. These conditions, however, which argue against operating the fuel bed and the gas producer at extremely high temperatures—above 1300 C.

A very hot fuel bed means that the gases will leave the producer at a high temperature, and thus lower the efficiency of the producer. The gain in capacity would, therefore, be accompanied by a loss in efficiency, unless the heat of the gases could be used for generating steam or preheating the air blast. A high temperature also favors clinkering. In the application of the results of these experiments to commercial producers and furnaces it will be necessary, of course, to consider the other questions which are involved.

Various explanations have been suggested to account for the presence of small amounts of carbon monoxide in the flue gases of boiler furnaces. Perhaps the one generally accepted by engineers is that the oxygen of the air first unites with carbon to form carbon dioxide, and that as this gas passes up through the bed it combines with carbon in accordance with the equation $CO_2 + C = 2CO$.

Assuming this to be the correct explanation, then the questions to be solved are what conditions favor this reaction and what conditions will tend to retard it. It has been shown by the authors that the higher the velocity of the gas and the thinner the fuel bed the less will be the percentage of carbon monoxide formed. A heavy fuel bed in the boiler furnace would therefore favor the formation of carbon monoxide. Also, the greater the supply of air to a given depth of bed the less would be the percentage of this gas formed; therefore with a hot fuel bed the formation of a small amount of carbon monoxide is inevitable. In order that this carbon monoxide may be burned to carbon dioxide in some way sufficient air must be added to the hot gases as they leave the top of the fuel bed.

The bulletin also contains a chapter by J. W. Clement and L. H. Adams on "Effective Temperatures for Water-Gas Generation."

The results presented show that a high rate of gasification combined with a high percentage of carbon monoxide and a low percentage of carbon dioxide and water requires a high temperature in the fuel bed.

The higher the temperature the better will be the quality of the gas and the greater the capacity of the producer.

The use of large amounts of steam is inconsistent with the realization of high temperature, and is, therefore, to be avoided.

Although these investigations were undertaken primarily to determine the conditions governing the formation of producer-gas, the results have an important bearing on the water-gas process.

They show that although with very low rates of steam supply the decomposition of the steam may be complete at 1100 degrees C., with higher rates of steam supply, such as are desirable in practice, a much higher temperature, 1300 degrees or 1400 degrees C., is required to obtain complete decomposition. The highest efficiency will be obtained by raising the temperature of the bed during the blast as high as is possible without injury to the producer. As the bed cools during the run with steam, the steam should be gradually reduced, and when the temperature has dropped to 1000 degrees C., the steam should be cut off.

The bulletin is of a scientific character and will be of interest to engineers engaged in gas producer and gas engine work. Copies may be obtained by addressing the Director of the Bureau of Mines, Washington. D. C.

ELECTRICITY AND CROPS.

Professor J. H. Priestley, of Bristol University, England, in the course of a paper on "Electricity as a Factor in Crop Production," described in detail the numerous methods in which electricity has been either directly or indirectly utilized in the production of a crop, with a view to either accelerating or increasing the yield. In one particular instance the discharge of high tension electricity from overhead wires had resulted in an increase of 39 per cent in a field of wheat. He pointed out that while the precise effect of electricity on the physiology of plants was still in doubt, the three factors affected were the air, the plant and the soil. On one farm a network of electric wires was erected over various fields of wheat, while other fields, where the same kind of wheat was grown, were

left in their natural state. The electrified wheat gave a yield per bushel varying from 13 to 39 per cent in excess of the yield of the non-electrified wheat. In these experiments the tension was transformed 100,000 volts, the wires, however, carrying only 0·10 amp.

Exactly what the electrical discharge does is not clear, but Mr. Priestley claimed for it a tonic or bracing effect raising the tone of the plant and increasing the momentum of development. Miss Dudgeon, of Dumfries, has investigated the effects of the Cooper-Hewitt mercury-vapor lamp, and shows reason for believing that its blue-violet light helps plants grown under it to greater sturdiness. The leaf-cells in the treated plants show a markedly greater accumulation of green coloring matter or chloroplasm. Mr. Priestley fully endorsed the value of Miss Dudgeon's experiments. The light in question also, he thought, "increased the strengthening fibre" in the plants submitted to it. He said that Miss Dudgeon had found the Cooper-Hewitt mercury-vapor lamp "extraordinarily efficacious, producing accelerated germination, increased growth, greater depth of color, and, more important still, no signs of the lanky, unnatural extension of the plant usually associated with forcing." The following figures show how many days earlier Miss Dudgeon's seeds germinated under the lamp than in the control greenhouse: French beans, 8; carrot, 15; cauliflower, 20; lettuce, 6; oats, 5; barley, 5; wheat, 8. The lamp was 4 ft. above the seeds, and the light was turned on two hours daily after daylight.

The lecturer also described some experiments of his own at Bristol, in which he employed a quartz mercury-vapor lamp which, he found, permits many more of the ultra-violet rays from the luminous vapor to pass out into space, so that it is possible to study the effects due more particularly to these rays, and to institute comparisons between plants grown directly in the light and others grown behind the shelter of a glass, i. e., with most of the ultra-violet rays cut off. He found that in the case of mustard seeds the process of germination was enormously accelerated. Further, seedlings can be grown for some time close to the lamp itself, the plants developing being extraordinarily sturdy, and of quite a different shade of green from the normal ones. The effect of the quartz mercury-vapor lamp at close range is to retard or to entirely inhibit growth but, at great distances, or behind a glass screen, it has a marked accelerating and invigorating effect if used as complementary to ordinary daylight. One extraordinary result obtained was that in the case of the mustard seedlings exposed to the lamp at close range the plants are of an absolutely glabrous type, instead of, as usual, very hairy. The plants close to the lamp do not possess, either on stem or leaves, a single hair. Further away from the lamp hairs develop only upon the side away from the light, and shaded behind glass the plants are approximately as hairy as usual. Thus it is clear, said the lecturer, that light of a specific color properly controlled will enormously accelerate germination, a matter of profound importance for putting valuable crops on an early market. The same electric light helps the plants to robustness, a matter of great import with many valuable but only semi-hardy crops.

ALUMINUM WIRE FOR MOTOR FIELD COILS.

The International Street & Interurban Railway Association reports that twenty-five electric railway companies in Europe are employing aluminum field coils in their motors. The section of aluminum wire to provide the same amount of conductivity as copper must be 1.687 times as large at zero degrees C. or 1.645 times as large at 100 degrees C. The actual coil, however, is no larger, because it has been found possible to oxidize the surface of the aluminum wire so that no textile insulation is required. The weight of the coils is about 50 per cent to 55 per cent that of a corresponding copper coil. This weight amounts to about 250 lb. for a two-motor car. The cost is also lower, even including the value of the scrap, which is higher for copper than for aluminum.

Most companies use cambric, paper or other insulation between the different layers of the aluminum field coils, but none between wires composing the same layer.

Several methods are employed for oxidizing the wire in order to provide the non-conductive surface. One company, while the coil is being wound, moistens the cambric insulation between the coils and also the wire itself with the brush. When the coil is finished and before the outer insulation is put on a current is passed through the coil sufficient to raise the temperature of the wire to about 100 degrees C. The insulation resistance of the surface of the wire then gradually attains its normal value. Another company anneals the aluminum wire by raising it to a temperature of 200 degrees to 300 degrees C. before the coil is wound. Water is applied as before, but the coil is baked in an oven and the process is repeated once or twice. The General Omnibus Company coats the wire and coil with a plastic material having a clay base which gives a mummified coil.

In addition to the other advantages of the use of aluminum the maintenance of the coil is low because its lightness reduces the injurious effect of the jars to which these coils are subject. Care must be taken in winding to avoid joints in the wire, because it is difficult to make satisfactory joints, and care should be taken, when soldering on the field coil terminals, to avoid the formation of oxide on the surface of the aluminum wire.

DEFINITION OF AN ENGINEER.

In the course of an address before the Technical Publicity Association of New York, Barrett Smith of the Stone and Webster Engineering Corporation said:

"There are so many men with ordinary endowments doing work that enables them to pass as engineers because it is related to engineering, that the impression of the outsider regarding the profession of engineering is apt to be erroneous. By the same token, the impression of the education of which these workers are the product is apt to be erroneous.

"An engineer is a man who conceives a new system or arrangement of known elements, to meet conditions in a way that will confer some economic or industrial advantage upon his constituents, and then actually creates this system or arrangement. An engineering education simply develops this faculty and the judgment which goes with it."

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue*. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Removing Short Circuits

L. C. Nicholson's startling method of removing a short circuit from a transmission line by shorting the generating station is like fighting fire with fire. As described by R. L. Mershon at the Los Angeles meeting of the A. I. E. E., quick-acting switches automatically short-circuit the station for five cycles when it is broken by expulsion fuses. This takes the voltage from the line and so clears the short.

The object of this method is apparently to prevent the system from being shut down or to avoid pulling the shorted line from the network. Where power is delivered to a system from one plant or from several plants tied together through transmission lines which join at points remote from any of the generating stations, this heroic treatment would seem practical, provided all apparatus in the power-houses is designed to withstand the ensuing strains. Where there are several plants it would be necessary to localize the break and exercise the Nicholson treatment through the plant directly connected with the trouble. The other plants would be unaffected except as they had felt the short-circuit. This all presupposes a short-circuit which will clear; that is, that there is no line damage whereby any wire of the circuit has fallen against another wire or the ground. Except to prove that it would not be of use, the system would be of no value in this latter case and would serve only as an indicator.

As to damage to instruments and apparatus in the power-house, every plant should be designed to withstand short-circuits, no matter where they may occur, and this might be near the power-house as elsewhere.

In the West several generating plants are often connected not only through the transmission network, but also connected directly to each other through a transmission line. Several circuits may also radiate in as many directions, each supplying a power district, and to still further complicate matters, they may be connected at other points with the network. Upon evidence of a short-circuit on one line, it is customary to immediately disconnect at both ends by the use of circuit-breakers. This saves other circuits and in most cases will not throw synchronous apparatus out of step. Much doubt has been expressed by operators if, in such systems, it would be wise to adopt the Nicholson plan.

Many of the Western plants do not use automatic controlling apparatus or even voltage regulators, and this plan has its adherents because a heavy short-circuit causing a tendency to lower line voltage and frequency will in most cases extinguish itself, causing no further damage than a momentary dip in lighting service and seldom throwing synchronous apparatus out of step. The personal equation enters largely in the methods of operation of complicated networks and it would probably take much demonstration under all of the many peculiar and unlooked-for conditions giving rise to the causes of short-circuits before the average operator would care to depend upon the proposed method of overcoming short-circuits.

PERSONALS.

C. E. Sloan is at Newman on engineering work.

Frank W. Eastman, representing Stanley & Patterson of New York, is at San Francisco.

H. B. Squeers, of the sales staff of Otis & Squires, San Francisco, is at New York City on business.

F. L. Robson, of the firm of Sloan & Robson, returned to San Francisco last Tuesday from Madeleine, Cal.

J. J. O'Brien, one of the vice-presidents of H. M. Byllesby & Co., of Chicago, left last week for the North.

H. R. Noack, of Peirson, Roeding & Co., returned to San Francisco last week from a Northern California trip.

B. M. Downs, vice-president of the Brookfield Glass Company, has returned East from the Pacific Coast via Seattle.

H. A. Wood returned to San Francisco during the past week, after a trip to San Diego on electrical engineering business.

W. W. Rockefellow, sales manager of the Western Electric Company, has returned to New York from a visit to the Pacific Coast.

Robert Carter, superintendent of the Coast Counties Light & Power Company, has returned to Santa Cruz after visiting San Francisco.

M. C. Miller, assistant to the president of the Allis-Chalmers Company, spent the past week at the San Francisco office of the corporation.

J. S. Cain, who has a controlling interest in the Hydro-electric Company which has rebuilt its power station near Bodie, is at San Francisco.

Leon M. Hall, who left last Tuesday for Carson and Reno, Nevada, will make some electrical engineering investigations in that part of the country.

F. G. Baum, of F. G. Baum & Co., returned to his San Francisco office during the past week, after making an engineering examination in the interior of California.

H. H. Hornsby, sales manager of the Sprague Electric Company's conduit and supply department, left last Tuesday for Portland, after spending some time in California.

R. S. Masson, chief engineer of the Electric Operating & Construction Company of New York, and general manager of the Arizona Power Company, is at San Francisco.

J. H. Thatcher, general manager of the Pacific Telephone & Telegraph Company with headquarters at Portland, recently returned to Oregon after paying a visit to the San Francisco office.

E. C. Bradley, general manager, and G. B. Bush, general commercial superintendent, of the Pacific Telephone & Telegraph Company, recently returned to San Francisco after a tour of the Pacific Northwest.,

George A. Damon, managing engineer for the Arnold Company, in charge of their work at Los Angeles, has been appointed dean of the school of engineering at the Throop Polytechnic Institute, Pasadena, Cal.

Norman Macbeth, formerly in charge of the illuminating engineering laboratories of the Welsbach Company, is now illuminating engineer of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company.

L. H. Newbert, the present manager of the Pacific Gas & Electric Company's Redwood district, will, on June 1st, take charge of the new appliance department, with headquarters at San Francisco. To fill the vacancy caused by his appointment E. W. Florence, district manager of the Pacific Gas & Electric Corporation at Fresno, has been transferred to the Redwood district. W. H. Henderson, manager of the Colusa district, has been transferred to Fresno.

Chief Engineer Straubeck, of the Wailuka Plantation in the Hawaiian Islands, recently spent several days at San Francisco as the guest of W. Jamieson, first assistant engineer of the Merchants Exchange Building. Mr. Straubeck is on his way to Germany for a vacation.

R. L. Mershon left for the East last Sunday, after inspecting a number of electric power plants around San Francisco Bay. In company with A. H. Babcock, he visited the power station and repair shops of the Southern Pacific Company's new electric lines in Alameda County.

M. Takahashi, electrical engineer with the Ashio copper mine of Japan, is inspecting a number of hydroelectric power plants in California in the course of a tour around the world. Mr. Takahashi is making an especial study of transmission line practice and also of the application of electricity to mining.

Thomas Mirk, of Hunt, Mirk & Co., has returned from San Diego, where his firm has a large steam and electrical engineering contract with the San Diego Consolidated Electric Light & Power Company. A low-pressure turbine is to be installed in connection with a large reciprocating engine and generators.

OBITUARY.

Richard Spencer, formerly manager of the Los Angeles branch of the Western Electric Company and recently in charge of their Buffalo house, died at Danville, N. Y., on May 6, 1911.

Peter J. Lynch, who died at Seattle May 1st, after an illness of only two days, was the district superintendent of the Pacific Telephone & Telegraph Company in the Puget Sound territory. He was well liked in California, where he held various official positions with the company for twenty years. He was superintendent at Oakland for several years and for one year acted as manager of the Philippine Telephone & Telegraph Company with headquarters at Manila. Mr. Lynch was aged forty-one years and left a wife and one daughter.

MEETING NOTICES.

The May meeting of the San Francisco Section of the American Institute of Electrical Engineers will be devoted to an inspection of the new Fruitvale power plant of the Southern Pacific Company. The meeting will be held on the evening of May 19th.

The thirty-fourth convention of the National Electric Light Association will be held in New York city, opening on May 29th and continuing until June 2d. The convention will, without question, be the largest in the point of attendance yet held by the organization. The remarkable success which has attended this association is well merited. It has done more for its industry than any other industrial association in this country. Through the interchange of ideas at its conventions rates have been universally reduced, service improved and a better understanding secured with the public. According to Secretary T. Commerford Martin the growth in membership during the past year has been large.

At the meeting of the American Society of Mechanical Engineers in New York, on May 9th, several important papers on the subject of patents were presented and discussed by E. W. Marshall, D. H. Haywood and E. J. Prindlow. At the spring meeting of the society, to be held in Pittsburg, Pa., May 30th to June 2d, cement manufacture will be one of the principal subjects considered. Among the other papers to be presented are "Commercial Application of the Turbine Turbo-Compressor," by R. H. Rice; "Purchase of Coal on the Heat-Unit Basis," by Dwight T. Randell; "Energy and Pressure Drop in Compound Steam Engines," by F. E. Cardello. There are also to be sessions on Gas Power, Machine-Shop Practice and Steel-Works Practice.

ELECTRIC RAILWAY DICTIONARY.

An Electric Railway Dictionary has been compiled by Rodney Hitt under the direction of a committee appointed by The American Electric Railway Association and published by the McGraw Publishing Company of New York. This is a step towards standardizing the nomenclature of electric car construction. It is arranged in two sections, the first giving an alphabetical list of definitions and the second a logical presentation of illustrations. This volume of over four hundred 9 x 12 pages, while intended primarily for electric railway men, should be of interest and value to every electrical engineer.

NEW CATALOGUES.

Thomas & Betts have given their line of boxes, locknuts and checknuts to Otis & Squires for the Pacific Coast.

The General Electric Company has just issued Bulletin No. 4820, which supersedes its previous bulletin on Curve Drawing Ammeters and Voltmeters.

Catalogue No. 25 from the Chicago Fuse Mfg. Co. is devoted to Stamped Steel Switch and Outlet Boxes, giving illustrations, dimensions and prices.

Fancleve Specialty Co., Jamaica Plain Station, Boston, Mass., have issued a complete catalogue of fittings for metal and wood moulding, armored cable, conduit and miscellaneous uses.

Railroad electrification is the subject of Circular No. 1517 from the Westinghouse Electric & Mfg. Co., giving illustrations and descriptions of a number of foreign and domestic electric railway installations.

The General Electric Company has just issued an attractive pamphlet entitled, "Charging the 'Electric' at Home." This pamphlet describes briefly that Company's Mercury Arc Rectifier as used for charging the batteries for electric runabouts.

The New York & Ohio Company, of Warren, Ohio, are issuing two illustrated folders, one giving a revised price schedule, and the other a revised discount schedule for the "Packard" incandescent lamps.

Allis-Chalmers Company have issued Bulletin No. 1622, in which is given a description of the Manhattan High Pressure Fire Service System, together with some of the results which have been attained with its use.

Bulletin No. 4799, recently issued by the General Electric Company, illustrates and describes in considerable detail several types of revolving field alternators manufactured by this company. Both horizontal and vertical shaft alternators are illustrated.

"Westinghouse Static Protective Apparatus," Folder 4110, is an attractive little publication recently issued by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. This folder, as the name implies, covers the line of static protective apparatus as manufactured by the Westinghouse Company.

Chas. C. Moore & Co., engineers, are distributing a handsome leather-bound memoranda book with renewable insert. Each sheet is perforated so that it may be easily torn out in part or in whole as the note has been properly attended to. This feature makes it particularly valuable to the engineering fraternitiy for whose use it has been especially designed.

The General Electric Company has issued an attractive bulletin, which illustrates and describes its Electric Fans for the coming season. These fans are made for either alternating or direct current, and in various styles and sizes to meet various conditions. The publication lists fans suitable for the home, office, and restaurant, and fans which can be placed on desk or table, or fastened to the wall or ceiling. The bulletin, which is No. 4806, lists also various small power motors.

The General Electric Company reports a contract for the season's requirements and an initial order of 5004 Calorite Leaf Unit flat iron, equipped with the "external spring" attachment plug, from H. M. Byllesby & Co., for their various properties. Also another order for 6000 flat irons of the same description from the Southern California Edison Co., of Los Angeles and vicinity.

Bulletin No. 4822, just issued by the General Electric Company, illustrates and describes its GE-98 railway motor, which was designed to meet the demands of heavy city and suburban service, and is suitable for either two or four-motor equipments. The motor is rated at 50 h.p. The publication contains dimension diagrams, characteristic curves and a table of schedule speeds.

TRADE NOTES.

The Kellogg Switchboard & Supply Company has closed a contract with the Farmers' Telephone Company of Omak, Wash., for complete central office equipment for the system.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., has just received a contract from the British Columbia Electric Railroad, of British Columbia, for two 45-ton locomotives with quadruple equipments of No. 301 interpole railway motors and automatic unit switch control.

The salesmen of the Kellogg Electric & Supply Company are distributing a unique paper match holder. Each match is labeled with the name of an apparatus type. On the reverse side of the folder is given the company name and the principal types of apparatus manufactured. Small cases in variously colored leathers hold these match folders, making an attractive advertising novelty.

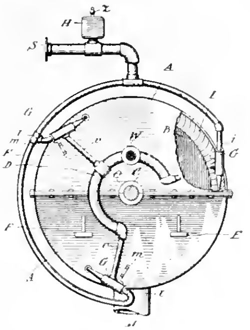
The Pelton Water Wheel Company has been awarded a Government contract for all of the hydraulic work and equipment for the new power plant near Fallon, Nev., in connection with the Truckee-Carson project. The contract covers two double-discharge Pelton-Francis turbines (spiral case type) of 830 h.p. each, to operate at 514 r.p.m. under a head of about 105 feet of water. Pelton oil pressure governors and Pelton relief valves, of special design, will be used.

The Cutler-Hammer Mfg. Co. announces the establishment of a new department to be devoted exclusively to the design and manufacture of electrical appliances for industrial heating. The resources of the company's large and thoroughly equipped New York factory will be principally devoted to the manufacture of this class of apparatus, under the direct supervision of Mr. W. S. Hadaway, Jr., who for many years has specialized on applications of electric heat to industrial purposes.

The Washington Water Power Company have just placed an order with the General Electric Company for two of the largest waterwheel driven generators ever constructed for their Long Lake plant. These will be three-phase generators of the horizontal type and will have a capacity of 13900 k.v.a. and will be of so liberal design as to be able to carry a 25 per cent overload continuously. They will operate at a speed of 200 r.p.m. and will generate current at a potential of 4000 volts. Four of these generators will eventually be installed at this plant. They are driven by I. P. Morris horizontal twin turbines each of 22,500 capacity at full gate, operating under a head of 170 feet. These are the largest waterwheels that have ever been constructed. The dam is 183 feet high at the deepest section and is the highest spillway dam that has ever been constructed. The potential of the transmission line will be 60,000 volts for the present, although the plant is designed for 110.

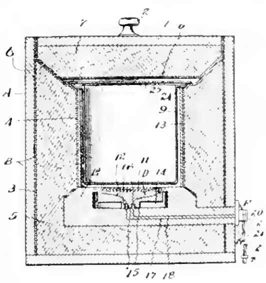
PATENTS

991,074. Compound Hydro-Steam Engine. David Maclean, Calexico, Cal. In a compound hydro-steam engine having several injectors connected to a steam line, which project their several jets of water directly upon the first series,



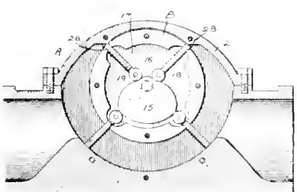
of a plurality of series of buckets combined with a segmental drum and a frame within which the several series of deflectors are attached.

990,927. Electrically-Heated Cooker. Charles E. Terwilliger, Santa Cruz, Cal. A cooking device of the class described comprising a casing, inner and outer shells disposed therein, a heat retaining filling between the shells, a cooking utensil within the inner shell, a heating element under the



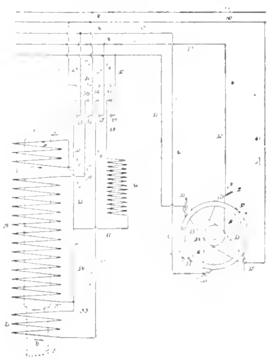
utensil, a chambered holder of non-conducting material disposed at the bottom of the inner shell and containing the said element, conductors embedded in the said holder for supplying current to the heating element, and a fuse device mounted on the casing and connected with the said conductors.

991,314. Rotary Pump. Ira Boyd Humphreys, Denver, Colo. In a rotary pump, the combination with a casing, of



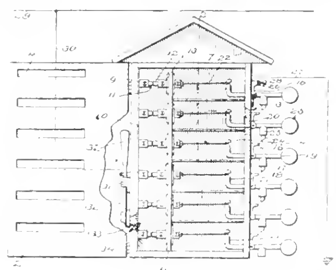
having slots therein, double blades received in the slots, webs connecting the blades of each double blade together, a runner mounted in the casing made in sections, said runner one section of said runner having a passage for the webs of the blades, a chamber formed between the ends of the two sections, a stationary shaft, and a cam on the stationary shaft received in the chamber, adapted to engage the inner ends of the blades and force them outwardly.

991,384. Electric Reciprocating Engine. William Armor Stedman, Millers, Nev. An electric reciprocating engine comprising a solenoid having a series of distinct superposed section windings, the middle winding being connected in series with each of the end windings; an operating electric circuit suitably connected with an electric source embodying said middle winding and one of said end windings of said solenoid; an independent electric circuit embodying a resistance coil and connected with the inactive end coil of said



solenoid; a supporting frame for said solenoid; a rotary switch having a plurality of curved metal sectors, a rotary switch having a plurality of curved metal sectors cylindrically arranged and adapted to be rotated; a plurality of brushes adapted to electrically contact with said sectors, said brushes forming the terminals of the said operating and independent circuits; and means for adjusting the said terminals to vary the relative distances between the said terminals to effect a prolongation of the circuit closure in one of the said end windings.

991,372. Automatic Fusible Lightning Arrester. Andrew Reid, Colorado City, Colo. In a lightning arrester, a housing, a plurality of fuses, a pivotally mounted weighted lever connected with one end of each of said fuses, means for connecting said fuses with a line wire, and means for connecting

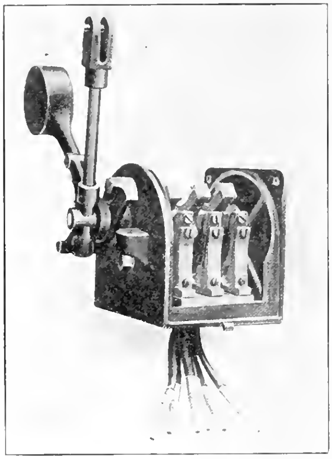


said levers to the earth, said means including a wire, a bracket pivotally connected with each of said levers, and a contact member connected with each of said levers arranged to engage said brackets respectively as said fuses are broken

INDUSTRIAL

AN AUTOMATIC FLOAT SWITCH.

An automatic float switch of new design has recently been placed upon the market by the Westinghouse Electric & Manufacturing Company. The new design embodies several features that recommend it highly for the control of motors driving pumps that empty into reservoirs, on drain sumps, sewers, etc. The operation of the switch is entirely automatic and the mechanism requires no attention beyond an occasional inspection and oiling. The switch is operated by a cylindrical steel float which plays between brass stops on a vertical rod, as illustrated; the stops are adjusted to the upper and lower water levels. When the float presses against either stop, a U-shaped tripping lever attached to the float-rod engages a pivoted weight-arm and carries it



Automatic Float Switch.

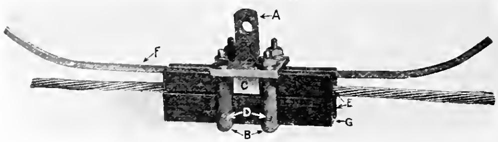
upward and around past the vertical position. The weight-arm then falls, engages an arm on the switch drum shaft, and snaps the switch open or closed, according to the direction in which the weight-arm is thrown. A buffer receives the force of the weight-arm's fall. When the float-rod is attached to the tripping lever, the pump will be started when the float presses on the lower stop and hence is properly arranged for filling reservoirs. With the rod attached to the other side of the lever, the switch is adjusted for drainage purposes, as the motor will be started when the float presses against the upper stop. The switch is of the drum type with renewable contacts and fingers.

The float and float-rod are heavily galvanized and are enamelled and baked. This finish effectually prevents rust. The standard float-rod permits maximum variations in level of six-feet.

These switches are made in two styles—double-pole for direct current, and single-phase alternating current motors, and three-pole for polyphase motors. The maximum capacity of these switches is 50 amperes at 550 volts. The motor is connected directly across the line and hence can be used only with motors that do not require starting voltage.

A NEW SUSPENSION CLAMP FOR HIGH TENSION CONDUCTORS.

In the transmission of high tension electric currents using suspension type insulators, it is common practice to use stranded conductor either of copper or aluminum. In order to suspend the conductor from the lower unit of each series, a clamp of some form is used. Heretofore, most of the clamps were made of metal but a new design, invented by Mr. R. A. Willson, General Superintendent of Railways, Washington Water Power Co., of Spokane, Wash., and used with great success on their transmission lines since their construction early in 1910, makes use of two wood clamping blocks in place of the metal clamps as ordinarily used. One of the chief advantages of this clamp is that, the wood being soft to a certain degree, the clamping members will not injure the cable. This is especially advantageous where aluminum cable is used, as it is well known that aluminum cable can be seriously injured by being clamped too tightly. Referring to the illustration, the clamp is attached to the clevis casting of the lower insulator unit by means of the sus-



Wooden Suspension Clamp for High Tension Insulator.

pension member "A," which is attached to the clamping members "E" by means of the U bolts "B." Grooves are provided at the top and bottom "G" of the clamping members for the insertion of arcing horns or rods. The illustration shows the arcing rod "F" placed at the top where it is ordinarily used. In order to prevent destruction of the clamp or cable by a flash-over, the arcing horn is electrically connected to the cable by means of the aluminum strip "C." The screws "D" are for the purpose of facilitating the assembly of the clamp on the line as they prevent the members from dropping apart. The clamp is pivoted at "A" so that breaking of the conductor will allow the clamp to swing, thus preventing kinking of the conductor. The clamp is somewhat more expensive to produce than some other designs, but the results in service seem to abundantly justify the expenditure.

Mr. Willson has made arrangements with The Ohio Brass Company of Mansfield, Ohio, to manufacture and market this clamp.

DATA ON DECORATIVE STREET LIGHTING.

"The Illumination of the Streets" is the title of a brochure just issued by the Holophane Company. While intended for popular distribution rather than for engineers, the booklet contains some valuable data on the subject and should be appreciated by all who are interested in the so-called "boulevard lighting" installations.

The Holophane Company's street lighting units have several definite advantages over other equipment, according to the data given. The units are the result of a long series of investigations and experiments by the Holophane engineers, and are designed to give the maximum of even illumination upon the streets and sidewalks with the minimum of objectionable glare. The comparative photometric curves published would indicate that the units are successful in both directions.

Artistic appearance, however, has not in this case been sacrificed to engineering considerations. The Holophane units are especially attractive and the various designs have a wide range or adaptability. A sketch of a lantern for residential districts strikes a new note in street lighting equipment, while even the standard shapes for the lighting of business thoroughfares have an air cf distinction quite unusual.

In view of the great interest everywhere manifested in improved street lighting, this publication of the Holophane Company comes at an opportune moment and should prove of more than passing interest.

MOTORS, CONTROLLERS AND RESISTANCES FOR ELECTRIC VEHICLES.

In order to meet the requirements of automobile manufacturers the General Electric Company's motors for electric vehicles are made in six sizes, which cover all classes of service from the runabout, speedy roadster and light delivery, to the 3 and 5-ton trucks.

They are designed for single-motor drive through counter shaft with double-reduction chain transmission. This design saves weight, space and cost, and gives high rotative speed which insures electrical efficiency. It also conserves the battery, thereby increasing the possible mileage, and permits the mounting of the motor on the chassis well up from the ground.

The mechanical construction is very simple. The frame and one head is made from a single piece of cylindrical steel casting, machined from end to end, thus combining minimum

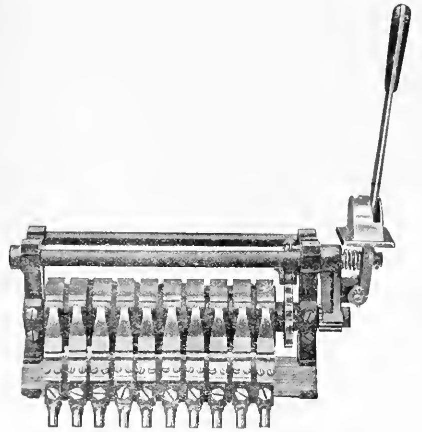
Motor for Electric Vehicles.

weight with maximum strength. The heads are fitted with improved annular ball bearings, which increase the efficiency, reduce the overall length of the frame, and require only occasional lubrication. Furthermore, in order to facilitate repairs, the form of the construction adopted permits the removal of the shaft without disturbing the commutator or winding.

Liberal electrical factors permit operation at high overloads for considerable periods of time without injury. The commutators have a large number of bars, and special graphite brushes of large area render the current per square inch of brush contact lower than that usually obtaining in electric motor practice. This is important where a storage battery is the source of power.

Since a suitable controller is fully as important as a proper motor for the satisfactory operation of electric vehicles, all automobile controllers made by the General Electric Company embody the continuous torque principle. This design insures freedom from jolts due to opening of circuit in passing from series to multiple connection of field coils, thus enhancing the pleasure of operating the smaller vehicles, and adding to the life of large trucks.

With single motor equipment, series-parallel arrangement of fields is the standard form of control, resistances being used on intermediate steps. The controllers for pleasure vehicles are provided with a comparatively large number of points, to permit of running slowly through traffic congested city streets, or at higher speeds over park and country roadways. This fine gradation of speed is not required in the case



Controller for Electric Vehicle Motors.

of commercial trucks, however, and their controllers have only a sufficient number of notches to safeguard the chain or gearing of the transmission.

The latest design of controller is of the cylindrical drum type, operated by a pinion and sector at one end. The sector is mounted on a countershaft which carries the operating lever or handle. The drum contacts are made of drawn copper tubing screwed in place on a treated wood frame. Horn fibre spacers are inserted to insure smoothness of operation and to prevent sparking. The contact fingers are of rolled copper stock, secured to phosphor bronze springs. The controller is designed throughout to withstand rough usage, and many of the parts can be used for different systems of connection. The operating handle is made from drop-forged steel, and can be formed to suit the requirements of the various makes of automobile, as to shape of seat and body outlines.

Cast-Iron Grid Resistance for Electric Vehicles.

The resistance provided is of the cast-iron grid resistor type, universally recognized as the most suitable for electric vehicle service. It is of sturdy construction, heavily insulated with mica, and provided with drop-forged terminals. All terminals, leads and contacts of each component part are marked with letters corresponding to those on the wiring diagram furnished, so that the necessary connections can be made properly by those who do not possess special electrical knowledge.

The Davis & Farnum Mfg. Company, of Waltham, Mass., have been awarded contracts for the erection for the Pacific Gas & Electric Company of a 100,000 cubic ft. gas holder at Chico, and a 150,000 cu. ft. gas holder at Petaluma. They have just completed the building of a holder at Oroville, for the Oro Water, Light & Power Company.

NEWS NOTES

FINANCIAL.

ONTARIO, CAL.—The remaining $80,000 of the $175,000 water bond issue of which $95,000 were sold December 5, 1910, have been sold to the Ontario National Bank, at a premium of $3775. The next highest of seven bids offered was that of Wm. R. Staats, Los Angeles. for $3710.

SAN FRANCISCO, CAL.—The $238,000 6 per cent Stockton Water Company bonds, which matured April 1, 1911, have been redeemed as fast as presented, and only a very small portion of the amount have not been taken up. As soon as these are presented, the mortgage will be cancelled.

ORLAND, CAL.—Bonds for the sum of $50,000 for the municipal water and sewer systems carried at the election held in this city by a vote of 123 to 3 for the bonds. It is proposed to use $25,000 of this sum for the construction of a sewer system and the balance for a municipal water system.

SAN FRANCISCO, CAL.—By a compromise between the gas company and the Board of Supervisors it has been agreed that the gas rate litigation, which has been in the Federal courts for three years, shall be settled by the equal division of the impounded 15 per cent and the establishment of a rate of 85 cents and 80 cents for the year beginning in July.

KLAMATH FALLS, ORE.—The properties of the Klamath Falls Light & Water Company, of Klamath Falls, Ore., have been purchased by the Klamath Falls Power Company, the transaction involving about $500,000. The purchase includes two plants in Klamath Falls, the transmission lines throughout the city and those extending to several towns about 25 miles away. The company is said to be a subsidiary of the Siskiyou Electric Light & Power Company, of Yreka, Cal., which was recently denied a franchise for transmitting energy to Klamath from its station on the Klamath River, about 20 miles distant.

SANTA BARBARA, CAL.—At a recent meeting of the directors of the Santa Barbara Gas & Electric Company it was decided to ask stockholders to ratify a bond issue of $1,000,000. The new bonds are to bear 6 per cent interest, the plan being to substitute them for the 5 per cent issue of the same amount which it has been found difficult to float. This plan will not increase the bonded indebtedness of the company, and will offer a more attractive bond to investors. At present $680,000 of the 5 per cent bonds are held as security for loans. The 5 per cent bonds will be called in as soon as the 6 per cent issue is placed on the market.

BAKER CITY, ORE.—A. B. Sterns, City Clerk, will receive bids until 5 p. m., the 29th of May, for improvement bonds of the City of Baker, Oregon, the total amount of the issues being $140,000, issued in amounts of not less than $500 each, to be issued for the improvement of the city water system in the sum of $90,000; for the construction of new reservoir in the sum of $25,000, and for paving of street intersections in the sum of $25,000. Bids must be separately made for each of said issues and may be for the whole or any part of. Each of said bonds is to bear date of July 1, 1911, payable 20 years from its date and will bear interest from said date of issue. Each bid to be accompanied by a certified check, payable to the mayor in the sum of 5 per cent of the amount of bid.

SAN FRANCISCO, CAL. The sale of $1,110,000 worth of the Hetch Hetchy water bonds by Treasurer McDougald at par over the counter has been authorized by the Supervisors. The offering is the amount for which no bids were received in April, and the money realized from their sale is to go for the construction of the Lake Eleanor dam, the building of about 80 miles of roadway, later to be used largely for the conduit line. and other work in the mountains. The sum of $10,000 was appropriated for the use of the city engineer in carrying on the survey and preliminary work around Lake Eleanor, and $5000 for the use of the city attorney in presenting the city's case before the board of army engineers on the question of revoking the Hetch-Hetchy portion of the Garfield grant.

INCORPORATIONS.

LOS ANGELES, CAL.—The Los Angeles Electric Vehicle Company has been incorporated with a capital stock of $200,000, by S. Hendricks, P. L. Lindley, W. L. Crawford, C. E. Nestor and J. A. Lighthipe.

CHELAN, WASH.—The Rubin Electric Power & Lumber Company, capital $500,000, has been incorporated by Wm. H. Schokel of St. Paul, Minn., Chas. Rubin, of Chelan. The latter is superintendent and manager.

SAN FRANCISCO, CAL.—Articles of incorporation of the Sacramento & Folsom Railway Company have been filed. The road is to embrace a distance of twenty-two miles and has a capital stock of $1,000,000, of which amount $26,000 is paid up. The directors are Francis V. Keesling, Herman H. Grau, Ernest L. Brune, J. W. Cook and K. Grau.

SAN ANDREAS, CAL.—Articles of incorporation of the Sacramento Power & Water Company have been filed here. A part of the scheme is to provide Calaveras, Sacramento, Amador, El Dorado and other counties with water. The incorporators are: Charles Chapman of San Francisco, Charles Barsotti of San Andreas, John Muldoon of Berkeley, Dudley Smith of Oakland, and C. J. Lancaster of Alameda. The capitalization is $2,500,000, of which each director has subscribed for $500 worth of stock.

VALLEJO, CAL.—Amended articles of incorporation of the Vallejo & Northern Electric Railroad, showing an increase of capital stock from $2,500,000 to $10,000,000 have been filed with the Secretary of State by Melville Dozier. Report has it, however, that when the Vallejo and Northern increased its capital stock it had the sole view of building its road up the Sacramento Valley from Vallejo to meet the Northern Electric. This will give the latter road a valley and water route to San Francisco The proposed extension will bring the road to Sacramento by way of Suisun and Woodland. A branch of the road is now operating from Vallejo into the rich Napa Valley.

TRANSMISSION.

MARCUS, WASH.—This place has accepted the offer of H. V. Gates of Hillsboro, Ore., to furnish Marcus with an electric lighting system.

NYSSA, ORE.—The Kingman colony is having surveys made for an electric plant on Snake River. The project is intended to cover 5200 acres.

SEATTLE, WASH.—The Council has authorized an expenditure of $75,000 for the construction of a new power plant on Lake Union at the foot of Nelson Place. The plant will be operated by water power and will generate 2000 h.p. daily.

HOOD RIVER, ORE.—The Pacific Power & Light Company is making preparations for improvements. A power line is to be extended to The Dalles. No. 4 copper wire will be used. It is announced $1,000,000 will be expended in these improvements.

ELMA, WASH.—The Olympia Railway & Power Company has asked for a franchise to erect poles and wires in the streets for the purpose of furnishing light and power.

ROSEBURG, ORE.—The plant 3 miles north of Roseburg which supplies the city with water and electric power and light was destroyed by fire. Loss $50,000. Kendall Bros., Pittsburg, Pa., owners.

NEZ PERCE, IDAHO.—President Z. A. Johnson of the Nez Perce & Idaho Railway, owner of the Nez Perce power and light plant near Greer, is contemplating developing the power site to its full capacity, 1500 h.p.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has been granted a franchise to supply this place with electrical current for heating, lighting and power purposes. Harry L. Powers is manager of the company.

PLACERVILLE, CAL.—Henry A. Meyers has filed a notice of an appropriation of 15,000 miners' inches of the water of the middle fork of the Cosumnes River. The announced intention is to store all the water in excess of a flow of 5000 inches in a reservoir to be made by the construction of a dam 100 feet high across the Middle Fork of the Cosumnes River. The purposes of the appropriation are to generate electric power and to furnish water for irrigation near the town of Plymouth. The proposed reservoir will store an amount of water equivalent to a flow of 400,000 inches for 24 hours.

SAN FRANCISCO, CAL.—A rumored disagreement in matters of policy between the officers of the Great Western Power Company was reported in recent press dispatches from Oroville as the cause of the recent resignation of H. H. Sinclair as vice-president of the company. This rumor Mr. Sinclair denies in a communication just made public, explaining that his relations with the other officers and directors of the company are very pleasant, and that while the demands upon his time made by personal interests in Southern California necessitated his resignation as manager he will, at the request of the directors, supervise the large amount of construction work for which the company recently set aside nearly $2,000,000. This extension of the company's power system is made necessary, Mr. Sinclair explains, by the rapid expansion of the business of the company, especially since its entry into the distributing field in San Francisco.

TRANSPORTATION.

MODESTO, CAL.—At last the protestants against the granting of a franchise to the Tidewater & Southern Railway, on Ninth street, in this city, have come to an agreement with the railroad people on every provision of the franchise ordinance before the Board of Trustees, and the ordinance will be passed at the next meeting.

SACRAMENTO, CAL.—A deed just executed is said to pave the way for the early building of a street railway through Elmhurst by the Sacramento Electric, Gas & Railway Company. The property was transferred from Louis F. Breuner to H. A. McClelland, who placed Elmhurst on the market. Permission was also obtained, it is stated, whereby the carline will be allowed to cross the S. P. Co.'s tracks. The extension of the car system will cost about $15,000

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company will soon submit a new ordinance to the Trustees, asking for a "cross-town" franchise. The "cross city" line will begin at Fifteenth and I streets, thence on Fifteenth to K, thence on K to Twenty-first, and on Twenty-first to P. Not only will this line place the Western Pacific depot in direct touch with the hotel district by street cars, but will also give street car connection with the depot from the junction of lines in the southern part of the city at M, P, T and Twenty-first and Fifteenth streets.

SAN FRANCISCO, CAL.—The City Attorney has advised Mayor McCarthy that the municipality can proceed at once to the construction of the greater part of the city road on Geary street despite the pending litigation involving part of certain sections; also that the city authorities have the right to deviate from the original route described in the bond issue ordinance; and finally, that when the city desires cessation of the operation of the company now running cars on Geary street under temporary permit from the municipality, all it has to do is give notice, and if the company does not within the time allowed remove its rails, the city may do so itself, turning them over to the company when it sees fit to do so.

OAKLAND, CAL.—The completion of that portion of the Oakland & Antioch Electric Railway project between Walnut Creek and Oakland for the construction and operation of which a two-million-dollar bond issue was recently authorized, is practically assured, through the formation by a strong group of New York capitalists of an underwriting syndicate. Sufficient money has already been subscribed to warrant the engineering firm of J. G. White & Co. The contract calls for a rock-ballasted road, with heavy electric welded track, the signing of a construction and supervision contract with the total mileage being 17½. It is understood that a profitable freight traffic is assured, contracts for the handling of lime and wine on a large scale having already been signed. The road will traverse a picturesque country, and with stage connections to Mt. Diablo pleasure travel is expected to add to the traffic from the San Ramon Valley to Oakland and San Francisco via the Key Route, with which the Oakland and Antioch has an operating agreement.

OAKLAND, CAL.—The work of electrifying the Seventh street local lines of the Southern Pacific Company was begun Saturday, when 400 men started constructing the additional track which must be laid between East Oakland and Melrose. The new electric system will necessitate relaying of practically all the track in East Oakland. General Roadmaster Corrigan of the Western division has taken personal charge of the first section of the work, as all the local and main-line trains running out of First and Seventh streets, have to be kept on schedule time during the course of the reconstruction of tracks. From a point located near the foot of Tenth avenue, through to Melrose, four tracks will be laid. The two tracks next to the bay will be used exclusively by main-line trains, while the others will be maintained for local traffic. At Tenth avenue the main-line tracks swing over to First street, while the local branch into Seventh street. The entire Seventh street system will be reconstructed without disturbing the steam-train service. The remodeling of the lines in Alameda for the electric system is practically completed, but a few more days of work remaining before trains can be operated on both lines. In Berkeley, too, the work is nearly done, but this portion will have to await the completion of the Oakland division before being changed into the new service. The work on Webster street will take but a short time, as only one track is used at any time, and there is but a short strip of road to rebuild. As fast as the construction parties lay track on the Oakland system the electrical department will set poles and finish the work. The entire broad gauge system is being held back on account of the Seventh street line, due to the delay incurred in securing the franchise. From 400 to 1000 men will be kept busy from the present time until the whole work is complete.

ILLUMINATION.

LOS ANGELES, CAL.—The Board of Supervisors has voted to accept the bid of the Thos. Day Co. of San Francisco, $13,360.26, for furnishing electrical fixtures for lighting the Hall of Records building.

ALAMEDA, CAL.—An estimate for the cost of reconstructing the municipal light plant has been made by the

electricity commissioners, showing the total cost for the proposed improvements to be $123,700.

TWIN FALLS, IDAHO.—The Council has passed an ordinance granting to W. W. Seymour and F. C. Brewer the right to maintain and operate gas plants and lay mains and pipes for the purpose of distributing gas over the city.

OREGON CITY, ORE.—A. L. Beatie has presented to the Council a gas franchise for which he made application to run 25 years. This was read the first time and on motion of Mr. Meyer referred to the finance committee and the city attorney.

LOS ANGELES, CAL.—The Board of Supervisors will receive sealed bids up to 2 p. m., May 29, 1911, for a franchise granting the right for a period of 40 years, to lay, construct and maintain a system of gas pipes under and along the public roads and highways of Los Angeles county.

WILLOWS, CAL.—The Northern California Power Company is about ready to begin the erection of a building over its new gas plant, near the water tower. The building will cover the tanks, holders, containers and machinery of the plant. It will be built of sheet iron. The laying of mains is now going on.

VANCOUVER BARRACKS, WASH.—The bids for furnishing electricity to the government in this post were opened, the bid of the Mount Hood Railway & Power Company, of Portland, being the lowest. A 75 horsepower motor to pump water for the post will be installed and will run 24 hours a day.

ORANGE, CAL.—The Southern Counties Gas Company, through its representative, A. I. Stewart, has requested the City Council to offer for sale a gas franchise in the City of Orange. Mr. Stewart states that a high pressure line will be laid at once. Orange will be first to get the line, being nearest to the supply plant. The franchise proposed calls for 50 years, which was objected to somewhat by the trustees.

MONROE, WASH.—At the last meeting of the City Council the petition of the Everett Gas Company, of which H. H. White is representative, was read and referred to the ordinance committee. Mr. White agrees to start work immediately upon the granting of a franchise and extend the main from Snohomish to this city.

PORT TOWNSEND, WASH.—The Western Steel Corporation, with principal place of business in Seattle, has made application to the Board of County Commissioners of Jefferson County, to grant to it a franchise for a period of 50 years to construct and operate a system of gas mains and pipes and a system of electric wires for the transmission of electric current.

WATERWORKS.

BEND, ORE.—The Common Council has granted a water franchise for the Lytle Addition to Steidl & Tweet.

WINLOCK, WASH.—Steps are now being taken by the Winlock taxpayers for an adequate water system for the city.

MEDFORD, ORE.—The Jacodson-Bade Company has been granted an additional contract by the City Council for the laying of water mains on E. Main, Roosevelt and Queen Anne streets.

SEATTLE, WASH.—The Board of Public Works has awarded to the Jahn Contracting Company, in the Leary Building, the contract for the Grand Boulevard water mains for $16,408,60.

COULEE CITY, WASH.—The County Commissioners have granted a franchise to the Northwestern Improvement Company, a right to lay mains, operate and maintain a water system in the town of Wheeler.

MODESTO, CAL.—Water Inspector Davis and City Clerk Thompson have been authorized to get bids on 600 ft. of 8-inch and 1500 ft. of 4-inch waterpipe for extensions to the West Side park and in other suburbs.

ILO, IDAHO.—The City Council has decided that Ilo must have fire protection and has ordered two of its members to prepare the necessary plans to begin the construction of waterworks. Water will be piped from Cold Springs Canyon and conveyed to a reservoir on the Old Ilo hill.

WHITE SALMON, WASH.—Engineer Geo. A. Kyle has completed a survey for the construction of an electric railway from this place to the S., F. & S. Railway and estimates the cost of construction at $50,000. Local capital will subscribe to part of the stock and the Mt. Adams electric line will subscribe the balance and construct the line.

SAN FRANCISCO, CAL.—After a conference between Mayor McCarthy, members of the public utilities committee of the Supervisors and certain directors of the Spring Valley Water Company, it was announced by the Mayor that the water corporation was soon to furnish the city officials with a complete and comprehensive report on the property now owned by the company

SACRAMENTO, CAL.—The scheme to sell to this city water rights near the source of the American River, which are represented as sufficient to give the city a mountain water supply and to develop 29,000 h.p. for a municipal lighting plant, will be laid before the Chamber of Commerce at its next meeting. To purchase these rights and to build the necessary dams and conduits for bringing the water to this city the cost is estimated at $3,000,000.

SEATTLE, WASH.—Bids are being received by C. B. Bagley, secretary of the Board of Public Works, for the improvement of a portion of North Fiftieth street, North Fifty-first street, North Fifty-fourth, Fifty-fifth, Woodlawn circle; West Fifty-fourth, West Fifty-second, First Avenue Northwest, Trinity Place, Terrace Drive, Scenic Place, Second Avenue Northwest, West Fifty-sixth street, Palatine avenue, by the construction of water mains, according to plans on file in the office of the Board of Public Works.

SACRAMENTO, CAL.—D. P. Doake of San Francisco, said to represent certain capitalists who are alleged to have secured certain water rights on the McCloud River, is making an offer through the Chamber of Commerce to sell out to the city for $165,000. The matter is to be discussed at the next meeting of the Chamber. The plan is to supply Sacramento with McCloud River water through a concrete conduit more than 200 miles long. The estimated cost of installing such a plant is $3,000,000. Mr. Doake and his associates ask $165,000 for the engineering work they have done, for their water rights and for securing permanent rights of way. The Natomas Consolidated owns valuable water rights on the American River.

KINGSBURG, CAL.—All the contracts for the construction of Kingsburg's municipal water system have been signed, and actual work is to commence at once. The work was divided up into several sections, but the principal contract has been awarded to Braun, Williams & Russell, of Los Angeles, who are to put in the system with the exception of the wells, hose, power house and the fire apparatus, and the amount of their contract is $19,447.10. A R. Gilstrap of this city is to bore the two 8-inch wells, which are to be 100 feet deep, for $250. Johnson Bros., also of this city, are to build the power house for $1003. The contract to supply 1000 feet of 2½ inch fire hose was given to the Bowers Rubber Works for $900. The water tank is to be of steel, will hold 60,000 gallons, and will rest on a steel tower 100 feet high. The tank itself is 18 feet in diameter, and 31.6 feet high.

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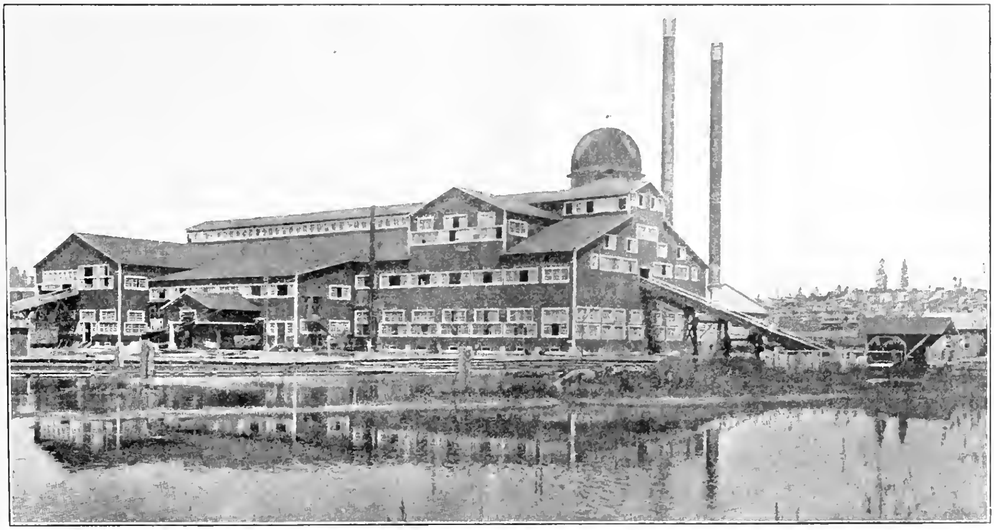
ELECTRICITY IN THE LUMBER INDUSTRY[1]

BY EDWARD J. BARRY.

The adoption of electricity for power in the lumber industry of the Northwest is of comparatively recent date although conditions are peculiarly favorable to its use. In the greater number of instances power can be generated locally at a cheap rate by utilizing the waste products as fuel. These waste products have, so far, little commercial value and in the past any fuel in excess of the quantity required for the steam units and auxiliary machinery has been conveyed to a burner and destroyed. Saw mills, as a rule, are situated in remote and sparsely settled districts where the problem of transportation to markets where the by-products of sawdust, shavings and inferior slab wood could be used, makes it scarcely worth while.

The generation of electricity for power offers a method of conserving this wasted energy by opening up a wide field for its application to the many demands for power outside of the sawmill itself. A brief record of the use of electricity in the mills of the Potlatch Lumber Company at Potlatch and Elk River, Idaho, illustrates these conditions. The Potlatch mill with a daily capacity of 750,000 feet, is one of the largest in the West and the power demand increased beyond the capacity of the steam units which consist of a 1500-h.p. Corliss engine, belt-connected to line shafting, for the sawmill, and one 1100-h.p. Corliss engine for the planing mill.



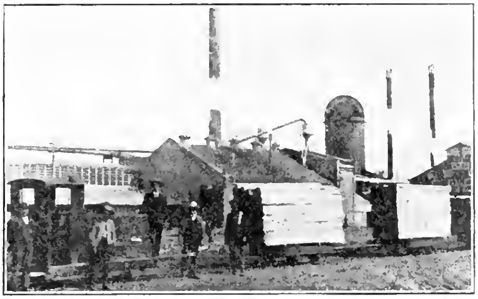
Potlatch Saw Mill.

A year ago one 800-kw. low-pressure, 2200-volt, three-phase, 60-cycle turbine generator was added to operate on the exhaust of the 1500 h.p. engine and has increased the available horsepower output by 60 per cent.

The turbine can also be operated on live steam if necessary in the event of a shut-down of the Corliss engine.

[1] Paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Los Angeles, April 25-28, 1911.

The output of this 800-kw. set is used to drive the machinery in the box factory, a 300-h.p. motor driving the blower on the sawdust conveyor; it supplies power for the machine shop, car shop and pump house; lights the mills and town at night, and during the summer months supplies 200 h.p. to a local brick-making plant. No increase in boiler capacity has been required and operating conditions are such as to occasion little extra expense in the way of attention. Storage battery locomotives are employed to handle the lumber from sawmill to dry-kiln and from dry-kiln to planing mill. These locomotives are seven tons in weight, including battery, and have a start-draw-bar pull of 3600 lb., and a running draw-bar pull of 1500 lb. at four miles per hour. Two 40-kw. belt-driven units are installed for charging the six locomotives employed. Four spare batteries are kept in reserve and can be placed in position on the locomotives in a few minutes in the event of a battery failing.



Transportation of Lumber From Mill to Yard by Electric Storage Battery Locomotive.

Snow has given considerable trouble in former years through blocking the tracks and this winter there was designed and put into service an electrically-driven snow brush which has proven eminently successful. The brush consists of a wooden cylinder with rattan canes projecting 16 in. (40.6 cm.) from its surface. This cylinder is driven by a chain geared to a 15-h.p. compound-wound motor mounted on the forward part of a lumber car, the battery for driving it being in the rear. Ater a heavy fall of snow this rotary plow is sent over the tracks clearing them completely and allowing work to proceed without interruption. Lead batteries are at present in use on the locomotives but nickel-iron batteries have been ordered and it is intended to change over to this type as circumstances permit.

When it was decided to adopt electric drive for the Elk River mill, at present under construction, a complete test was made to determine the horsepower required to drive the different machines in the mills.

The machine under test were disconnected from the line shafting and belt-connected to a motor of the estimated horsepower. Wattmeter readings were taken over a period of ten hours on normal load and from this data the necessary information was obtained.

The band mills were found to take from 30 h.p. at no load to as high as 275 h.p. on full load, and it was decided to install 200-h.p. wound-secondary motors for use at Elk River. There are three motors of this type.

The edgers have 75 and 50-h.p. squirrel cage motors, respectively.

The planers in the planing mill are driven by 75-h.p. motors. In cases where it was considered desirable, liberal use has been made of wound-secondary motors.

The power equipment at Elk River consists of one 800-kw., 600-volt, three-phase, 60-cycle turbo-generator and one 500-kw., turbo-generator. A switchboard of eleven panels installed in the turbine room, controls power and lighting feeders to the different departments. For lighting the town and outlying districts the voltage is stepped up to 2200 volts, with 2200-220-100-volt step-down transformers at centers of distribution.

A 50-kw., 600-220-100-volt transformer is used for sawmill lighting, and in the event of a burn-out provision has been made at the switchboard for connection to the steam exciter set, which can be switched

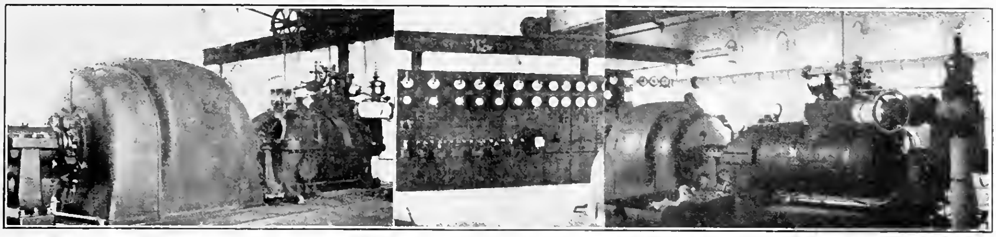
Elk River Mill and Power Station.

over for this work alone. The 25-kw. motor-generator exciter set can then be used for both generators.

A 50-lamp regulating transformer is used for the series arc system on the log pond and for street lighting in town. The sawmill is intended to run nightly, thus making the question of lighting one of importance. This is especially so in lumber grading which calls for powerful, evenly distributed light, with an absence of shadows. Experiments made at Potlatch have convinced us that tungsten clusters and single drop lights give the best effects and in the end cost least for maintenance. Arc lamps inside the mill have been discarded entirely. In the filing room, the saw sharpeners and stretchers are driven by individual motors of two and three h.p. and the small forge has a motor-driven blower. The entire system, both power and lighting, is installed in conduit, reducing the fire risk to a minimum.

Electricity will be used on the log pond for dredging, as the pond bed has a tendency to silt up and impede the passage of logs to the conveyor.

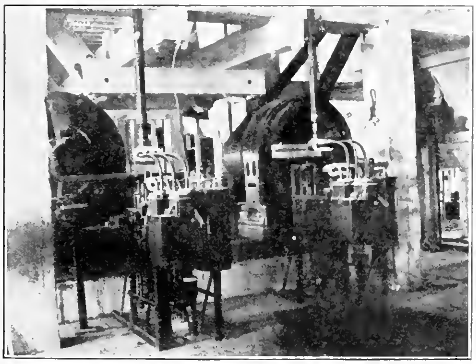
It is intended to use a rotary cutter directly in front of the intake of a powerful pump and convey refuse to the shore over pontoons supporting the pipe line. The pump and cutter will operate from a barge to which the supply wires to the transformer will be attached. The voltage will be stepped down from



Switchboard. 500 kw. and 800 kw. Turbines. at Elk River Plant.

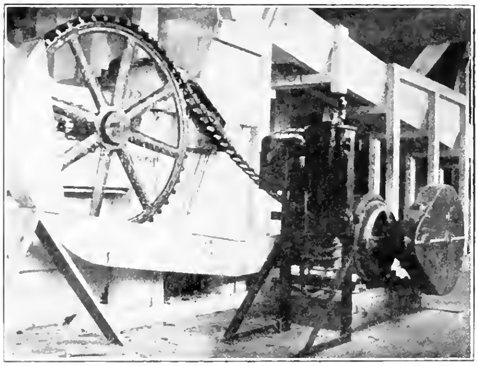
2200 to 440 volts at the motors, and three cable drums will pay out or haul in the wire according to the location of the dredge. It has been decided that a 35-h.p. motor will be required for the pump and a 25-h.p. motor for the cutter. If necessary a small motor may be installed for raising or lowering the arm supporting the intake pipe and cutter.

As soon as weather conditions permit the Potlach Lumber Company intends to experiment with electric drive on the logging machines in the woods, with the view of superseding the steam donkey engines at present in use. There are many drawbacks to the use of steam engines, not the least of these being the ever present risk of fire from cinders and sparks. Every care is taken to minimize this risk but the wholesale devastation in the forests of Idaho, Washington and Oregon last summer has naturally turned the attention of lumber companies operating in the fire areas, towards any method which offers even a partial solution of this difficulty. Water for the boilers must be hauled wherever the donkey engines are located as it is useless to depend on getting it locally except in the rare instances where a stream is within reach. Fuel has to be cut down and sawn into the proper lengths, creating a considerable labor item. A watchman has to be on duty every night during the winter to keep the water from freezing, an occurrence more frequent than desirable, when it comes to starting up in the morning.



Two 200 h.p. Motors Driving Band Saws.

Electric logging presents one or two new features in transmission work, the chief difficulty being that the location of the consuming end of the line must, of necessity, change constantly. The transmission line must be guarded against the danger of falling trees, but as it will be always in the rear of logging operations it will be possible to follow the track over logged off land, reducing the risk to a possible interruption, in hilly country, through a tree rolling down from higher ground. When a section has been logged over and a permanent change has to be made in the direction of the transmission line it would appear that a saving could be effected by installing light lattice work steel towers in the first instance. The towers could be set down and guyed to convenient stumps. The line would parallel the logging railroad practically throughout its entire length and when it was necessary to change the location these towers could be taken down and loaded on the cars. The wires and insulators would have to be removed in any case and, as the construction crew will be on the spot, it would take little extra labor to remove the towers also. The length of span will be from 350 to 400 ft. and the height of tower from ground 30 ft. The size or character of the wire will not be settled definitely until the nature of our requirements is known. The current will be 22,000-volt three-phase, 60-cycle. At each logging engine there will be a portable sub-station containing one 150-kw., three-phase, 22,000-550-volt, step-down transformer. From the secondary of the transformer a three-core steel-armored flexible cable will be led to the motor. This cable will be built up in sections with suitable connectors until a limit of 1800 ft. is reached, when it will be necessary to extend the line. This distance will permit of clearing a large area, as the steel logging cable has an effective reach of 3000 ft. The motor will be of 150 h.p. capacity, and of the phase-wound type driving by means of friction pulleys.



Chain Driven Conveyor and Starting Apparatus for Wound Secondary Motor.

A controlling panel with current-limiting relay to automatically introduce resistance into the rotor circuit in the event of the log striking an obstruction, will be installed on the platform beside the motor. This principle has been applied with success on electric shovel work and prevents the annoyance of a constantly tripping circuit breaker. A circuit breaker will be used to prevent damage to the motor should the power demand rise to an excessive value in the event of the obstruction proving beyond the capacity of the machine.

If successful there is scarcely a limit to the uses of a power supply carried into the forests and the natural outcome would seem to point to an extension embracing a complete electrification of logging railroads. Within four miles of Elk River there are two waterfalls of 85 and 102 ft. (25.9 and 31 m.) respectively which could supply upwards of 5000 h.p. There are numerous little settlements at present remote from any center of power supply, which doubtless would welcome the opportunity to secure energy to assist in development.

MOTOR DRIVE VERSUS LINE SHAFT.

BY H. P. PITTS.[1]

The tendency of modern shop equipment is toward individual motor drive. That is, having a separate motor for each individual machine, driving it either by gear, chain, or belt. There is a question whether all points are considered when deciding between individual or main-shaft drive. It may be that the individual motor, like our modern card index system, is just a little overdone.

Let us consider the line shaft. In the first place ordinarily too little attention is given to this part of the equipment. In the machine shop the highest priced machine tools are operated by the most skilled machinists. The shafting is in the care usually of a laborer whose duty it is to "oil up" once a week and to let it go at that; he knows nothing about alignment, is apt to pay no attention to the fact that the timbers to which the hangers or bracket boxes have been bolted have become twisted or have shrunk, leaving the nuts loose, and that the shaft becomes out of true, due to these apparently small matters. The overhead shafting should have careful attention, inasmuch as it is sometimes said to utilize thirty per cent of the power required for the shop. The writer recently in discussing this matter with a well known shop superintendent in San Francisco was informed that the greatest precaution was taken and care given to minimize the losses in the shafting in his shop, so much so that every morning at eleven o'clock a skilled machinist was employed to go over the line shafting and countershafting thoroughly, taking temperature of bearings and using a pointer gauge against the shaft to determine whether or not it was running true. If anything was found requiring attention it was repaired during the noon hour. This is a very wise precaution and could be instituted by every works where shafting is the driving element. The result is that the starting current on the motor is reduced to a minimum and the piece of apparatus that is supposedly taking thirty per cent of the power is kept in as good shape as the lathe operated by the most skilled mechanic.

[1]Industrial Engineer Pacific Gas & Electric Co.

As a rule machine shops, when shaft-driven, require for their operation less than thirty per cent of the power at which the individual machine is rated. Therefore, if the machines are classified properly, and the line shaft is cut up into sections, and we will say ten or fifteen machines driven from each, a motor of one-third the capacity of the sum of the full load requirement of each machine will do the work and give a high line shaft efficiency. This is due to the fact that not one-fifth of the time is a machine taking its full driving capacity, notwithstanding that it may be in operation nine-tenths of the time, for the reason that part of the time is taken to set the piece of work up on the machine, and part of the time in taking finishing cuts, polishing, and so on. Now these fifteen machines are never doing the same operation at the same time, hence the motor has a chance to equalize itself.

Let us consider the individual drive. First of all a machine to be properly equipped should have a motor equal to the capacity of work that the machine will be called upon to do. No other machine is going to help it out. If an overload is thrown on it (and motors are not built these days to carry an overload very long) the motor will drop in speed. In other words, the machine cannot do more work than the motor will drive. If a new steel tool be put on the market whereby increased speed may be used (and the machine shop practice has been revolutionized in this respect in the last ten years) a higher duty cannot be had from this machine on account of the motor.

Second, under these conditions one is compelled to buy fully three times the motor capacity. And that is quite an item at $12 a horsepower. Nothing is to be gained in space; in fact, countershaft-driven machines are more compact as to floor space. Under either condition all tools of the same class will be grouped and as closely as possible.

Modern shops have their wires in conduits in concrete floors. For the individual drive more conduits will be required. Especially is this last feature objectionable in cases where the individual drive class of machine has to be moved and set up in a different place, and such things are not uncommon. It will never be located just right for the conduit connections. It will mean digging into the concrete and extending the leads. There is another feature of no small importance. A good talking point in this class of motor drive is that the motor is idle when the machine is stopped. But it must not be forgotten that the starting current of these motors runs into two hundred to three hundred per cent of the operating load. The starting current is going on at a diminishing rate, however, while the motor is accelerating. Shaft-driven machines accelerate much faster. It cannot be said to be an argument against shaft-driven machines that they take up room overhead. There is always lots of room overhead; it is the floor space that counts. The cost of belting will not be a much larger item than the gear, link-chain, or belt-drive of the individual drive.

It is not the object of this article to discredit the individual drive (there are places where it is almost indispensable), but to draw out a few points to be considered when a man is almost persuaded to buy three times the motor capacity he really requires.

OIL BURNERS.

BY M. C. LORD.

We will take up the different phases of oil burners, dealing with the most important (atomization) first.

The gravity of oil from different fields varies from 12 to 32; in the California oils 12 being a heavy semi-solid substance in cold weather, and even some of the lighter oils will not flow freely in cold weather. This necessitates that steam pipes be led into the tanks in order to get the oil to flow to the pumps; which should be located as near the oil tank as possible.

An objection to heating the oil in the tank is that it gives off gas which causes the pump to lose its priming. This is corrected by some builders by means of an air chamber connecting over the suction valves on the pump to take up the gas which would otherwise pass to the burner and cause irregular action, from which more "flash backs" occur, than from any other cause.

The oil is further heated by discharging into a receiver connecting to the burner, and heated by a steam coil led into it, to further liquify the oil and assist in atomizing.

Of the some ten thousand burners on the market, none of them with the use of any agent (steam or compressed air) atomize the oil perfectly, and the majority of burners depend on forcing the oil through a small orifice in order to bring the greatest number of particles of oil in contact with the atomizing agent. The hair or stringy particles of oil soon pile up in the orifices and clog the burner.

The external method of mixing the oil and the atomizing agent at the tip of the burner or by means of small holes near the tip, increase this difficulty.

The internal method of mixing inside the body of the burner by small orifices makes the matter more difficult because an increase of the pressure does not as readily blow out the obstruction as would be the case if the smallest section of the burner was at the tip.

The proper solution of the difficulty appears to be in diverting the direction of flow of the oil several times in the body of the burner while mixing with the atomizing agent; thus avoiding the passing of the oil through small orifices, which readily clog up. Where steam is used as the atomizing agent, to which there is no great objection where water is plentiful, more air has to be admitted and a great deal of fuel can be wasted, even when the fire does not show it to the practical eye, if there is not the proper amount of air admitted at the proper place.

Frequently it is advisable to remove a couple of bricks from either side of the furnace, and admit air on either side of the bridge wall at its base, where it will strike the most active point of combustion. Too much air is almost as bad as not enough. It takes oil to heat it and as four-fifths of the atmosphere is a non-combustible gas it is an expensive waste of fuel. The proper method is to analyze the smoke-stack gases and increase the air until they show a little escaping oxygen.

A great many oil burners have been condemned from improper installation, and boilers ruined from improperly built bridge walls that deflect the flame against the boiler, which is so intense as to drive the water away from that part of the sheet, and blistering results.

Bridge walls are an important factor, and should be built with a view to getting an even distribution of heat as near as possible over the entire heating surface of the boiler. A few pounds of salt mixed with the fire clay and used as a grouting to spread over the brick will prolong the life of the bridge wall as it will form a glaze that the fire will not affect. Retarders placed in the tubes are objectionable because they lessen the draft and intensify the heat in the firebox where it is the greatest, decreasing the life of the boiler accordingly.

A burner which will show the best results under one type of boiler with a light oil, may not operate at all satisfactory, using a low gravity oil, for the burner may keep clear and the flame be such as to give a good heat distribution with a light oil, and in attempting to use a heavy oil get poor results. Hence we see a burner used successfully for a year or more and then be displaced by another type when the company signs a new oil contract.

The first requirement is an even distribution of heat over the entire heating surface of the boiler, which may be accomplished by an external atomizing burner using 25 gravity oil (which is a light fuel oil) in a water tube boiler distributing the flame moderately well. But if we attempt to use 14 gravity oil in the same burner, we will find a pyramid of carbon piling up in front of the bridge wall which must be removed.

This carbon means so much of the best of the fuel wasted and it may pile up sufficiently to injure the boiler by diverting the flame to one spot, which we find to be frequently the case where heavy oil is used by an external atomizing burner, as the oil reaches the point of atomization in globules, and a great part of it is blown off in a solid mass, part of which burns, the balance forming a pyramid in the furnace except part of the latter which pass up the smoke-stack in the form of free carbon.

Small pieces of semi-solid matter lodge in the slits or holes in the tip of the burner and if the pressure banks up in the atomizing line fast enough, will blow out in a solid mass to be partially consumed unless they choke the burner and put the fire out, when there is a good chance for some one to get severely burned, in which case I might mention that cylinder oil, or even the crude oil itself is a very good remedy to apply to the burns.

Where oil below 18 gravity is used, pre-heating is necessary to get good results. When we are confronted with the problem of getting rid of the asphaltum which will be deposited on the walls of the preheating chamber, the easiest method to overcome this difficulty is to fit the chamber with a removable sheet iron lining which can be taken out by placing a removable head on the pre-heating chamber when it can be thrown in the furnace and the asphaltum burned off readily.

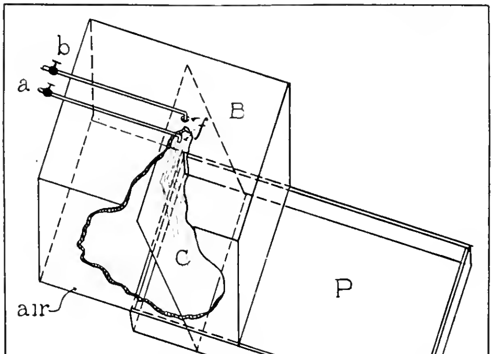
The oil burning problem has interested more inventors in the last few years than most anything else, but there is still a well-earned reward for the man

who can invent a burner which will atomize all the oil that passes through it.

A serious problem in small isolated plants is the getting up of sufficient pressure to atomize the oil in starting fires. Some plants install small boilers which are fired with wood until they get sufficient pressure to operate the burners under the main boilers. This is additional expense and loss of time.

The writer devised a self-atomizing burner some four years ago and a description of the same may be of interest to some isolated engineer as the entire burner can be easily made on the job.

Fig. 1 shows the burner complete, which can be made from a casting or sheet iron will do as it will be in use only until steam pressure is high enough to run the atomizer.



Self Atomizing Oil Burner

A pan of cast sheet iron partially covered by the box B, contains the plate C placed directly in the furnace door. Sufficient oil and waste is placed in the pan P to come up to the point D and is ignited; the flame passes up in the box B heating the plate C and, as soon as the plate C is hot, cold water is turned on at b, dropping on the hot plate through the hole f in box B. Immediately the water strikes the hot plate it spreads over the surface and the oil turned in from the pipe a, dropping on the film of water confines it on the plate C where it generates steam, making a miniature explosion, which passes through the surface of the oil, atomizing it and giving a hot fire which soon raises steam.

A new aluminum alloy is described in a paper recently read before the Birmingham branch of the British Foundrymen's Association. The result of adding aluminum to copper causes an immediate increase both in the strength and in the ductility of the copper, the ductility attaining a maximum at 7.35 per cent aluminum. Beyond that it fell, and when 11 per cent was reached the alloy became too brittle to be of any commercial value. Heat treatment had little effect upon alloys containing less than 7.35 per cent aluminum. Beyond that they were stiffened by heat treatment at 800 degrees C. Alloys containing less than 7.5 per cent aluminum were not amenable to cold working, though they were improved by hot rolling.

THE COMING CHICAGO CONVENTION OF AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Unusual interest is taken in the forthcoming annual convention of the American Institute of Electrical Engineers, for it will be held in Chicago on June 26 to 30, inclusive, and it has been many years since the convention met in that city, although the electrical attractions of Chicago and vicinity are exceptional in interest and variety. Among these points of interest may be mentioned the Ryerson Physical Laboratory of the University of Chicago, where the atomic theory of electricity has been demonstrated by most interesting experiments; the electric furnaces in the steel mills at South Chicago; the enormous electric plant at the Gary, Ind., steel works, driven by gas engines; the great central stations of Chicago, famous for their size and modern design; the hydroelectric development of the Chicago Drainage Canal; "Underground Chicago," with its network of electrically operated freight tunnels; the latest large automatic telephone system; several of the largest manually operated telephone exchanges in the world; street railway and other substations of unusual interest; possibly the largest street railway shops in the world, with electric drive throughout.

The convention will meet in the new Hotel Sherman, the most recently completed of Chicago's group of modern hotels. The sessions will be held in the handsome Louis XVI room, which will seat 700 people and can be connected with adjoining apartments to seat 1500 if desired.

While the list of papers to be presented at the convention is not complete, the following partial list of papers that will probably be presented shows the diversity of subjects to be considered: "Economical Design of Direct Current Magnets," by R. Wikander; "Catenary Span Calculations," by W. L. R. Robertson; "Currents in Inductors of Induction Motors," by H. Weichsel; "Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires," by Major G. O. Squier; "Electrolysis in Reinforced Concrete," by C. E. Magnusson; "Induction Motor Design," by T. Hoock; "The High Efficiency Suspension Insulators," by A. O. Austin; "The Electric Strength of Air,' by J. B. Whitehead; "Electrification Analyzed, and Its Application to Trunk Line Roads," by W. S. Murray; "Telegraph Transmission," by F. F. Fowle; "The Cost of Transformer Losses," by R. W. Atkinson and C. E. Stone; "The Costs of Railway Electrification," by B. F. Wood; "Induction Motor for Single-Phase Traction," by E. F. W. Alexanderson; "Magnetic Properties of Iron at 200,000 Cycles," by E. F. W. Alexanderson; "Electric Storage Batteries," by Bruce Ford; "The Characteristics of Isolated Plants," by P. R. Moses; "Elevator Control," by T. E. Barnum.

A committee of fourteen local members of the Institute has been appointed to make the arrangements for the convention. Mr. Louis A. Ferguson, 120 West Adams street, Chicago, is the chairman of this committee. The program will include visits to points of interest and various social events, and it is confidently expected that the 1911 convention of the Institute will be the most successful in its history.

A CURIOUS FORM OF CONTRACT.

The accompanying contract is the basis upon which a 75 kw. electric power plant has been installed at Papeete, whose streets had heretofore been lighted with oil lamps. The street corners are lighted with 100 c.p. incandescents. 40 c.p. bulbs being used elsewhere, and also being used after 11 o'clock. Consul North Winship reports that "the natives stand and gaze at these wonderful new lights by the hour, and many long voyages are made by the curious inhabitants of neighboring islands just to have a look at the brilliant city." In addition to this 3000-light plant, the owner operates 74 telephones on the island and maintains a wireless telegraph station.

Papeete, 28th December, 1910.

To the Mayor of the City of Papeete, Tahiti:

Worshipful Sir:—I have the honor to submit the following proposition for the extension of the electric lighting of the city, which has already been in use for several weeks, but which cannot be extended to include all the streets and places unless the municipality engages to maintain this mode of lighting for a period sufficiently long to justify the necessarily heavy expenses to be incurred to light the city entirely, that is to say, for a period of at least five years.

I propose lighting until 11 o'clock at night the Quay of Commerce from Fare Ute to the Manutention at the corner of the Hotel Tiari Annex, Rivoli street, from the East Bridge to the Gendarmes Barracks, Petite Poligne Street, Market Place, and the intersection of Bonnard and Collette Streets, i. e. all the center of the city, with lamps identical to those at present in use for street lighting, which light these streets so well that it would be possible at any point to tell the time by an ordinary watch.

To produce such a good lighting, which is equalled in very few large cities of the world, it would be necessary to place a lamp at each street corner mentioned.

At all the other intersections of the city streets the lighting would be done by means of lamps of half the power of those above described from half an hour after sunset until 11 o'clock at night.

At all the extremities of the streets such as following the Ramparts, and on the main road, and at Patutoa, lamps of half the power of the above would be sufficient. These last would even then be about 5 times more powerful than the actual oil lamps.

If I stipulated in this manner the power of the lamps to be used instead of speaking of their intensity in candles, or carcels, it is because these units, although they should, it is understood figure in the contract to be made, offer no base to the imagination for the luminous intensity, whereas when I undertake to light the principal streets, in such a manner as to tell the time by a watch I make clear the beauty of the lighting that I offer you, and the propositions indicated for the other lamps allow one to clearly imagine their lighting power, much better than would be the case, in mentioning the nominal candle power of each lamp.

From 11 o'clock at night all the large lamps would be put out, and replaced by lamps of the same lighting power as those on the ramparts. I estimate the total number of lamps necessarily lighted altogether to be 93, (29 large, 11 medium, 55 ordinary).

The lamps would be lighted as indicated above from half an hour after sunset until half an hour before sunrise, during 15 nights per month, all the installation and upkeep at my expense, for approximately the same price as actually costs the oil lighting, i. e. 7200 frcs. per year, on condition that the municipality assists me for the motive power with water which today runs to waste, i. e. the quantity of water which would run from an opening of 1¾ in. or 44 mm. at a pressure of 3 atmospheres from half an hour after sunset to half an hour before sunrise. If the available pressure should be increased the opening should be proportionately diminished.

To rebutt the pretensions of certain people interested to the effect that the quantity of water thus used would be so great that the city's water supply would be affected, it is sufficient to draw your attention to the tap which I have the honor to present herewith, which should serve as maximum opening to my installation and compare it with the piece of pipe attached thereto, which represents the dimension of most of the supplies in the city for which a charge of 5 francs per month is made.

Furthermore it is well to call your attention to the fact that the water plugs have a diameter of 53 mm. or a superfice half as large again as the tap of my hydraulic motor, and every one knows that these water plugs remain open often for several days at a time, the night also, without depriving the city of water. How then, would it be possible for a plug much smaller and open only during the night to do so.

But, however, the municipality would always have the option of stopping all, or part of the water, that it could supply me with, without having to give reason for so doing, only in this case, the price of the lighting would necessarily be increased in order to allow me to pay for the considerably increased quantity of combustible that would then be necessary, i. e. all decrease of pressure, of quantity or hours of water supply, would cause a simple proportional increase of price, this increase being calculated on the base that the entire withdrawal of the hydraulic power would double the price of the lighting. Also if the city supplied me with more hydraulic force than that provided for, the price of the lighting would be diminished in proportion by a rebate of 10 per cent for every 20 per cent of increase of hydraulic power supplied. This observation applies equally in the case the city supplies me with hydraulic power at other hours than those mentioned above. It would be fitting that in this manner the city should in time be lighted without cost, the supply of water entirely paying for the lighting.

I should always be held to assume the entire lighting even if the water were entirely stopped, for a determined length of time.

The 15 days of lighting per month proposed, could be advantageously divided or sectionized in such manner that the lamps would be lighted during the hours and nights when there would be least moonlight.

Furthermore if during a night which should be normally moonlight, there should be bad weather, the artificial light could instantly replace it, shutting it off again when the moon should come from behind the clouds.

The city would in this manner only have to pay as supplement for the few hours during which the electric light would have been necessary.

If however at any moment it should be found that the 15 nights or better the 15 times 11 hours or 161 hours of lighting per month, should not be normally sufficient no matter how divided between the 30 nights, of the month, the Mayor would always have the power to increase the period of lighting in consideration of increase proportional to those above.

If the additional lamps were used only in a temporary manner such as for a fete, etc., the cost of installation should naturally be supported by the city. And no derivation whatever should be made from my mains without my consent.

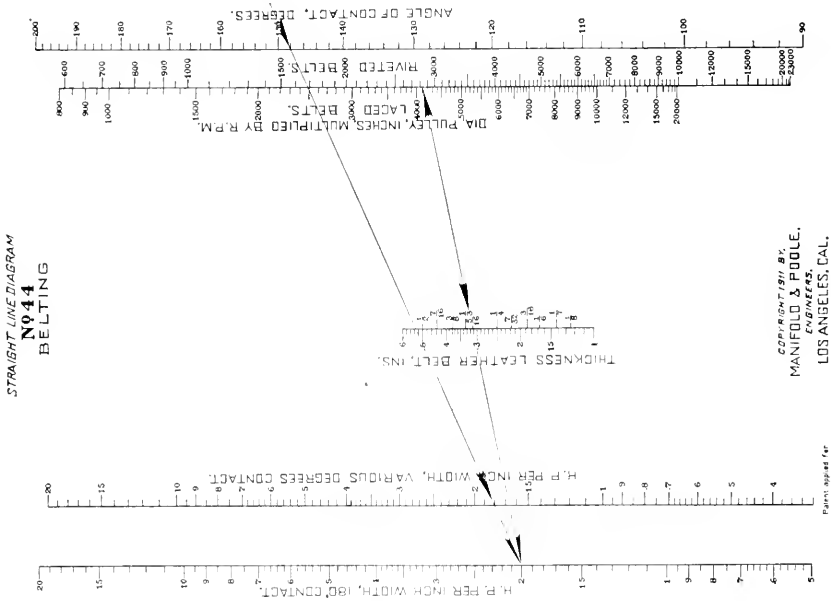
I undertake to commence the proposed lighting within two months, excepting a few lamps at a distance such for example as those at Patutoa and the Main Road, etc. For those it would probably be necessary to wait about a month or two more. I will furnish it is understood, guarantees for the performance of the contract to be made under the conditions and with the delays stipulated.

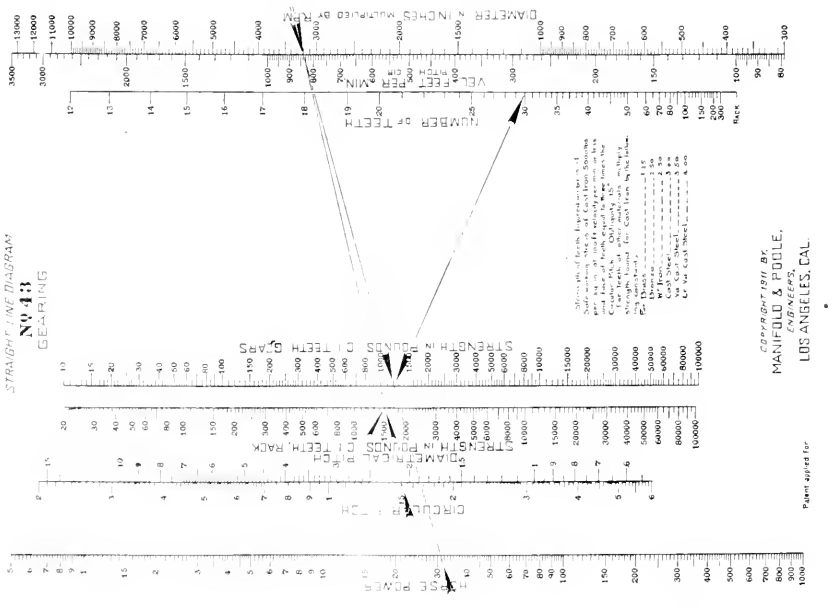
I have the honor to ask as simple justice to render me that at the expiration of the term I should be given the preference over all others on equal conditions, for the lighting of the city by whatever system it may be, according to the progress that science may have made from now. O. G. D.

GRAPHICAL SOLUTION OF GEARING AND BELTING PROBLEMS.

The accompanying straight line diagrams give a simple and rapid method of computing gearing and belting. They are used by permission of the authors from a forthcoming enlarged edition of their book on "Straight Line Engineering Diagrams." In each case the method of operation can best be understood by a typical example, the general principle depending upon the use of a string or straight edge to carry a line from a known point on one scale to a known point on another scale, solutions being found at the points of intersection on the remaining scales. The necessity of revolving the line around a point is indicated by double arrows.

Example for No. 43.—A cast iron gear has the following dimensions: Pitch 1½ in., face 4½ in., number of teeth 30, diameter pitch circle 14.32 in. What is the strength of the teeth and what horsepower will it transmit at 222 r.p.m.?





Solution: Multiply the diameter 14.32 × 222 = 3179; from this point on Scale No. 8, run to 1.5 on Scale No. 2, and find strength of rack tooth on Scale No. 4 equal to 1500 lb.; revolve index on this intersection and connect to 30 on Scale No. 6, and find strength of gear tooth 1220 on Scale No. 5; revolve on this 1220 and connect to 30 on Scale No. 6, and find strength gear toor 1220 on Scale No. 5; revolve on this intersection and connect again to 3179 on Scale No. 8, and find horsepower 31 on Scale No. 1.

Had the face of this gear been only 3 in. the h.p. would have been proportionately reduced, and would equal 31 × 3 divided by 4½, equal to 20 2/3.

It will be noticed by inspection of Scales 2 and 3 that 1½ circular pitch is very nearly equivalent to 2.1 diametrical pitch. The exact figure is 2.0944. Also by inspection of Scales Nos. 7 and 8, the diameter in inches multiplied by r.p.m. = 3179 as above, is equivalent to a velocity of pitch circle of 835 ft. per min.

Making the angle of obliquity 20 degrees instead of 15 degrees adds about 15 per cent to the strength of the gear.

Example for No. 44.—How many h.p. will a belt 5/16 in. thick and 10 in. wide transmit to a pulley 20 in. diameter, running 205 r.p.m.? Laced belt.

Solution: Multiply 20 in. diameter of pulley by 205 r.p.m. = 4100; then from 4100 on Scale No. 5 run to 5/16 on Scale No. 4, and find on Scale No. 1 h.p. per inch of belt 2; multiply by the width of belt 2 × 10 = 20 h.p. Should the angle of contact be 148 degrees, from 2 as found on Scale No. 1, run to 148 on Scale No. 7 and find 1.8 on Scale No. 2, which multiplies by the width 1.8 × 10 = 18 h.p.

CONSULAR NOTES ON THE ELECTRICAL INDUSTRY.

Panama.

The only lectric-light company in Panama is the Colon Ele tric & Ice Supply Company, which has one centr.l station and charges the following prices: For installation, $3; for connection, $1; for one 40 vatt tungsten lamp, $1; for one 16-candlepower carbon-filament lamp, $0.50; for one 32-candlepower carbon-filament lamp, $1; and in addition a charge of $1.75 a month is made for each light.

The company has a five-year contract with the National Government, dating from February 18, 1909, for the electric lighting of public offices, buildings, and the streets of Colon, under which it received for service during the month of January (1911) alone $1733. This would aggregate nearly $20,800 a year; and if to this amount is added the $15,000 paid by private consumers for current, some idea of the company's annual income may be obtained. The company has a monopoly of supplying Colon with ice, which it retails at 2½ cents a pound; and in conjunction with the ice plant there are cold storage facilities from which a neat sum is realized.

West Indies.

Contracts for electric lighting have been entered into by the Colonial Government and by the municipalities of Basse Terre and Pointe a Pitre severally with a merchant in the first-named city.

The municipal contracts were made four or five years ago and contain a penalty of $1 for each day's delay after notification that service is demanded, but this notice has never been given and there are thus no arrears to be paid. The contract with the colony was approved on September 1, 1910. The merchant has no means for carrying out his agreement, and proposed to pay for construction out of earnings, but he is now willing to cede his contract to a constructing company until such company shall be completely reimbursed. Ample water power is to be had at Basse Terre, but other power would have to be used at Pointe a Pitre. The total cost of plants and lines has been estimated at $55,000 to $60,000.

France.

Electric Jewel-Box Alarm.

A useful invention in the way of a cash and jewel box with an electric alarm attachment has just been placed upon the market in Paris and has every prospect of finding a ready sale both here and in the United States, though so far as known there has been only one sample box sent to the latter country as yet. This alarm box is said to be the invention of Mr. Paul Weber, of Vienna, Austria, and is covered by patents in several countries of Europe as well as in the United States.

The invention, briefly described, is as follows: In the bottom of the jewel box is placed a small mechanism consisting of a dry battery, a magnet, and a system of levers, the whole forming a device not unlike a telegraph instrument, which may be electrically charged by moving a small lever fixed and concealed in the side of the box. The sound is made by means of a bell and clapper similar to those on a telephone instrument. In the center of the bottom of the box is a small orifice, through which hangs suspended this pendulum. As long as the box is stationary this pendulum hangs perpendicularly and does not close the electric circuit. But if moved only in the slightest degree one way or the other, or if the box is raised off the table, the pendulum drops down, thus closing the circuit of the electrically charged mechanism and causing the alarm to sound. It makes a noise as loud as an alarm clock and does not cease ringing until it is "shut off." This can only be done by opening the lid of the box and shifting a lever. It would therefore be a noisy article for a would-be thief to attempt to steal.

Germany.

In a recent debate it was brought to the attention of the Reichstag that there are in Germany at present only three great groups in the electrical industry—the General Electrical Company, the Siemens-Schuckert Company, and the Bergmann-Elektrizitaetswerke.

It is rumored that efforts are being made to bring about a fusion of the Siemens-Schuckert and the Bergmann interests. The relations of the General Electrical Company and the Siemens-Schuckert people are already close, consisting of agreements relative to certain classes of products, important contracts, etc. The fear was expressed in the Reichstag that sooner or later the three companies would join forces and form a monopoly at whose mercy would be not only private consumers, but also the Government, which will be a heavy user of current for its electric

railways. These concerns manufacture every description of electrical supplies, and in addition install electric plants. By reason of their enormous capital they can finance the plants which they put up with their own products, engineers, etc. Their contracts not infrequently contain a clause binding the other parties to purchase supplies only from them.

In addition to these great companies there are numerous small concerns that manufacture one or two kinds of electrical supplies and together employ some 60,000 workmen. Further, there are in every city small firms which install electric lighting, etc. The necessity of protecting these less powerful factories and concerns was brought to the attention of the Reichstag.

Sweden.

A considerable increase was made during 1910 in the amount of water power utilized for the generation of electricity; 21 new power stations, representing an aggregate of 103,530 horsepower, were completed.

Of this amount, 40,000 horsepower is represented by the State installation at Trollhatten, in the Gothenburg consular district, already the seat of extensive electric plants. The remaining 63,530 horsepower is represented by 20 private plants located in various parts of Sweden. It is stated that new installations now under construction will add 115,000 horsepower to that which was available January 1, 1911. Of this amount the Government station at Porjus will produce 50,000 horsepower and seven private plants the remainder. Five older stations, representing 7650 horsepower, were rebuilt in 1910.

The municipal electric power station in Gothenburg secures part of its current from Trollhatten and generates the balance here in a steam-operated plant. Both alternating and direct current are furnished, the rates per kilowatt hour being 38 cents for lighting, 6.7 cents for lifts and elevators, and 4.8 cents for motors and power. The total amount of electric power brought to and produced in Gothenburg in 1910 (by the public service, excluding private plants) aggregated 16,211,593 kilowatt hours, of which 12,023,839 came from Trollhatten and 4,187,754 were generated in the steam plant. The aggregate loss of energy amounted to 2,424,714 kilowatt hours, or 14.95 per cent.

The uses to which the net power was put were: Greater industries, 5,185,028; street car lines, 4,165,277; harbor cranes and derricks, 53,678; Trollhatten power station, 18,630; private lighting, 2,400,002; private motors, 1,453,566; public lighting, 163,615.

HIGH SPEED DIFFICULTIES.

BY H. G. REIST

The author of this paper, which was part of an address at the Clarkson School of Technology, is designing engineer with the General Electric Company. His talk was concerned with some of the problems of the electrical engineer from the viewpoint, not of the operator, but of the designer.—Editor.

The high speeds of the steam turbine, as compared with the lower speeds of the reciprocating engine, have introduced several difficulties, including great mechanical stresses and difficulty of balancing. The high speed is necessary because to get the best results, the velocity of the periphery of the turbine wheels must have a certain relation to the speed of a jet of steam as it issues from an orifice. The maximum velocity of steam coming from an orifice, with a pressure used ordinarily in boilers, say about 150 lbs., is about 4000 feet per second, or about 45 miles per minute. The highest efficiency in a steam turbine with one wheel would be attained if the speed of the periphery of the wheel was about equal to one-half of the speed of the jet of steam, but we do not know of any way of building a wheel that can run at one-half the speed of a jet of steam, since the centrifugal stresses in the wheel become so great that any metal that is available for the construction of turbine wheels would fly to pieces. We must, therefore, be content to run at a lower speed and a lower efficiency. By passing the steam through two wheels, the wheel velocity may be greatly reduced and still give good efficiency. A further reduction in speed and an increase in efficiency may be made by taking a part of the energy out of the steam on the first wheel; then allowing the steam to come almost to rest and starting it over again through a second nozzle against a second wheel and repeating the process, in some cases three or four times. This produces a multi-stage steam turbine, and enables us to obtain quite a high efficiency at speeds that are safe with the materials available for the construction of the rotating parts.

Steam turbines are generally used for driving dynamos. It is easier and better to connect a dynamo directly to the shaft of the steam turbine than to belt it; and so it follows that dynamos must be built for the turbine speed. Before we had to bring the speed of the dynamo down to match the engine speed at a considerable inconvenience. Now, because the steam turbine runs so very fast, we must make electric generators that run faster than we like to run them.

The electric generator, or dynamo, is a complex machine, being built up of a large number of parts of thin iron, of copper wire and of insulating materials. The insulating materials consist of varnished cloth, paper and mica. All these materials are of a soft and yielding nature. This makes the problem of holding them together without injury, a difficult one when high speeds are encountered. The centrifugal forces are so great on the surface of the rotors that each pound of material must be held with a pressure of 4000 lbs. to keep it in its place. A piece of copper wire must be held every inch of its length else it will be bent and deformed. If it is unsupported at any space along its length, it will bend into that space almost as though it was putty. The speed of the outside of the revolving part of a dynamo driven by a steam turbine in some cases is more than 20,000 feet per minute, that is, over four miles. Some parts of the generator do not have sufficient strength to hold themselves and must be held by bands of steel. A band of steel an inch square in section around some of the revolving parts would be strained to nearly 12,000 lbs. to hold its own weight. In many places parts not capable of holding themselves must be supported. It must be done by material that has considerable strength after holding its own weight. For this reason materials

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of more than ordinary strength must be used. All rings of metal must be put on the shaft firmly because when they rotate, they enlarge, due to the centrifugal stresses, and if they are not shrunk on with considerable elongation in the first place, they will become loose. To avoid this, the parts must be put on so tightly that the metal will be stressed more than the stress that will be produced by rotation. If this is not done, the ring will stretch enough to become larger than the shaft and will be loose. This would cause trouble with the balance. One time it would be touching on one side of the shaft and then on the other. This would cause the machine to shake badly and parts of it would wear rapidly.

One of the difficulties of operating machinery at very high speeds is to get the rotating parts perfectly balanced, so that they will run smoothly without shaking. Wheels and other revolving pieces of machinery are usually balanced by laying the shaft on which they are mounted on two smooth and level rails, so that the wheel and shaft may roll over on the rails readily, allowing the heavy portion to come to the bottom. By adding the right amount of weight to the rim of the wheel at the top, the wheel may be balanced so that it will lie quiet with any portion of the rim at the top, that is, it will remain in any position to which it is turned and brought to rest. This produces what is known as a "static balance," and for most machinery it is of sufficient accuracy for practical use. This method is accurate within its limits only for wheels or discs which do not have much length along the shaft. The rotating part of an electric generator usually has considerable length along the shaft, the length being frequently greater than the diameter. Such a mass cannot be balanced perfectly standing still, since an irregularity in the balance on one end of the cylinder may be offset by a corresponding irregularity on the other end of the cylinder, so that while it is apparently in perfect equilibrium, it may not run smoothly. If two or more wheels are mounted on one shaft, it is necessary to balance each wheel by itself before putting them on the permanent shaft.

In building up rotors of turbine generators we frequently build them up in sections or discs a few inches in length, and balance each section before they are all placed together to form a cylinder. In order to have such structures rotate without vibration, they must be balanced by a running balance. We must determine how much weight is necessary at each end and where it must be located when the part is rotating. This work is done by means of balancing machines. These are very ingenious machines that have been devised during the last few years, especially for manufacturing parts to be used on steam turbines and on machinery driven by steam turbines. The balancing by these machines depends on a principle that is not very well known except by persons actually engaged in the work of designing or building high speed machinery. This principle is that a revolving body tends to rotate around its center of gravity, and if allowed to turn about this point, it will run smoothly. The behavior of a body rotating around its center of gravity is familiar to all of us in the spinning of a top when it has "gone to sleep." A spinning top is said to have "gone to sleep" when after it has started to spin it has made a few gyrations and has settled down so that it seems almost motionless. By taking advantage of this principle it is possible to locate very accurately just where weights must be added on a rotating body, and by a few trials, the correct amount, so that such bodies can be made to rotate without vibration, at very high speeds. All parts must be made rigid and solid, and every precaution must be taken so that parts will not become displaced while running.

This brings us to another very interesting phenomenon in connection with high speed machinery that is of sufficient importance to be studied. It is what is known as "critical speed" of a revolving structure. Perhaps I can convey some idea of what we mean by "critical speed." It is well known to engineers and musicians that a string stretched between two supports, or a reed or a metal rod if supported firmly at the ends, or at one end, will vibrate at a definite pitch or rate if the unsupported portion is displaced and allowed to move freely on returning. The steel shaft on which the revolving part of a machine is mounted, may be regarded as a reed supported at both ends, and it will behave like a reed if it is set into vibration, that is, it will vibrate at a definite rate. It is well known that a vibrating reed may be made to vibrate farther, although not more rapidly, by repeating impulses on the reed. Vibrations at any other rate cause a discord and tend to check the vibrations in any given reed. The pitch of a shaft, that is, the number of vibrations that it will respond to, is usually large—perhaps from 2000 to 3000 per minute. If now, an unbalanced wheel is mounted on a shaft and run at a low speed, it does not tend to set up vibrations in the shaft corresponding to its pitch; but, as the speed increases, there may be a time at which the speed, that is, the number of revolutions of the shaft, occurs as often per minute as the natural period of vibration of the shaft regarded as a reed. Under this condition the shaft will respond to the impulses caused by the turning of the unbalanced wheel. Each revolution of the shaft increases the amplitude of the vibration of the shaft, and if the speed was maintained at this rate for any length of time, the vibration of the shaft might become serious enough to permanently injure it, or some other parts of the machine. This speed is what is known as the "critical speed." In ordinary machinery this condition is rarely met with, because the pitch of a shaft is usually many times that of the number of revolutions, but on steam turbines and steam turbine generators the speed of the rotating part is such that we frequently run above the critical speed. "Above the critical speed," the revolving part will rotate around its own center and will run particularly smoothly. The revolving part, like the top, might be said to have "gone to sleep"; like the top, to get into this state it must first go through several vibrations, the amount of such vibrations depending on the degree of unbalancing, the stiffness of the shaft and other factors. As there is some danger of injury from the vibrations to the parts in running through the critical speed, as I have tried to point out, it is only under exceptional conditions that machines are run above the critical speed. This can usually be avoided by increasing the stiffness of the shaft, but sometimes the limitations of the designs are such that this cannot be done.

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E. B. STRONG, President
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C. L. CORY, Secretary

DIRECTORS
R. J. DAVIS A. M. HUNT A. H. HALLORAN C. L. CORY E. B. STRONG

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electricity in the Sawmill

The lumber mill as a power consumer has long been a will-o'-the-wisp to the electric plant in search of a load. The old millman argues that his waste wood is good fuel for a steam plant whose engine runs the mill, only a few of the more progressive recognizing the advantages of an intermediary electric equipment. The greater flexibility of operation, the increased output and the reduced fire hazard are well illustrated in the Potlatch Lumber Company's plant as described in this issue. They fully compensate for the extra cost of electrical apparatus as compared with the old-fashioned drives, especially as an electrically-driven mill is often insurable if the power plant is isolated from the mill.

The obvious benefits to be derived from such an isolated plant suggest the further superiority of transmitted electric power from a hydroelectric plant. Assuming that the fuel cost is nil, the charges for depreciation, maintenance, interest and attendance of a steam power plant are seldom less than .007 cents per kw.-hour. Power can be supplied at this price or lower to many mills who could thus obviate not only the first cost of installation and the subsequent wages, but also all near-by fire hazards. The resulting benefits to the mill and to the power plant are mutual.

Loaded Phantom Circuit

While three New Yorkers telephoned to three Denverites last week, eight Chicagoans were also simultaneously telegraphing to eight New Yorkers over the same two circuits. While duplex telegraphy has been employed for more than a generation and while it has long been possible to telephone over wires transmitting telegraph messages, this feat sets a new record for long distance telephony. Incidentally it is also significant of an early solution of the problem of telephoning 3000 miles from the Atlantic to the Pacific which will mark the signal culmination of years of patient effort on the part of the telephone engineer. Another ideal is made real when longinquity may thus instantly become propinquity.

The modern magic carpet by which this marvel has been wrought is the loaded phantom circuit. "Loading" consists in distributing inductance coils along the line to reduce the attenuation of the electric impulse and thus make telephony possible over greater distances. In "phantoming," three telephone sets are connected in parallel over two circuits properly paired and transposed so that non-interfering communication may be held. In this manner four wires can be made to do the work of six.

While both loaded and phantom circuits have been successful singly, it is but recently that a loading coil has been devised which can be applied to a phantom circuit. The combination gives a greater range of transmission than is possible with a loaded physical circuit and thus extends the sphere of long distance telephony.

Common Sense In Contracts

The proposal for an electric lighting system in the Society Islands, as printed elsewhere in this issue, has been the source of no little amusement to several engineers who are sticklers as to the form of engineering contracts and specifications. We are not informed whether the author of this literary engineering oddity is fully posted on the law of contracts, but he certainly exhibits great commonsense in presenting his proposition to the untutored minds of the Mayor of Papeete and his counselors. There can be no doubt as to what he intends to do and how he proposes to do it. As much cannot always be said of some contracts we have read. Furthermore, it landed the job.

Low Head Hydraulic Development

Our Eastern visitors often ask why the low-head power possibilities of the West are not developed. The great rivers of Washington, Oregon and California, with their large flow and swift current, resemble Eastern power sources and seem to offer fewer difficulties than do the high-head streams. The Columbia and the Sacramento, together with their tributaries, and many other smaller streams more remote from power markets, or having less constant flow, have an even grade and a slight fall per mile. There are a number of sites where dams might be erected and power devoleped, but a brief calculation shows that the ratio of cost to power available is out of all proportion to that of high-head developments higher in the mountains.

In the Northwest there have been several successful low-head developments for irrigation purposes, but in California the only example of any size, the 3700-kilowatt Folsom plant, is inoperative during the summer low-water period of the American River. Their massive headworks and frequently long canals are more costly than many undeveloped high-head possibilities which long-distance transmission renders available.

High Tension Automobile Ignition

The development of the gas engine has made possible a prime mover of relatively high efficiency, indispensable to many industries. Its remarkable refinements since the introduction of automobiles and power boats well exemplifying that "necessity is the mother of invention," and have made possible the use of heavier-than-air flying machines.

Were it not for the electric spark the clumsy ignition schemes of the earlier gas engines might still be in use. The low tension make-and-break spark, long used as the only dependable means of igniting the compressed charge of hyro-carbon gas, has now almost been displaced by the high tension jump spark system, due to its simplicity and notwithstanding its uncertain operation. The indifferent success of the low tension magneto as a substitute for primary or secondary batteries brought about the high-tension magneto.

Good results are obtained with the jump-spark if all parts of the apparatus are in working order, but there are several points between the battery and the plug where troubles may be experienced, from the exhaustion of the battery to the smutting of the spark points. In this system a low tension current supplied to the primary winding of an induction coil is made to oscillate through a make-and-break vibrator, actuated by the iron core of the coil. A pulsating high tension current is supplied from the secondary winding to the leads which pass to the opposite sides of the spark plugs. A condenser placed across this line so amplifies the discharge between the spark points as to give sufficient heat to ignite the mixture. The string of sparks delivered are not hot enough to ignite the mixture instantly, but there is a time element, both in the delivery of the spark and the ignition, which necessitates that starting of the spark must be advanced ahead of the actual time that it is desired the explosion shall take place. The more rapid the explosions, the greater must be this advance.

In the development of the magneto to simplify the jump spark system, it was aimed to make the action as nearly automatic as possible, to eliminate weak points and to supply a spark of sufficient rapidity and heat to ignite the charge almost instantaneously.

Until recently little was known about the design of induction coils and magnetos to obtain the best results and at the same time be automatic, fool-proof and durable under the severe conditions found in automobile work. Many clever devices have been developed and put to use, but the practice as first aimed at seems to prevail. The high tension magneto has an "H" armature with a single fine wire winding of many turns and generates a high electromotive force. This is connected to a revolving condenser on which is mounted a make-and-break switch. The e. m. f. is momentarily generated as the armature breaks the magnetic continuity between the pole pieces and for this reason the armature speed does not affect the current generated, except as the increase of speed increases the impulses of e.m. f. The condenser switch operating in synchronism with the revolutions of the armature, opens at the proper time to discharge the condenser through the line connected to the proper spark plug, the distribution being accomplished through a system of brushes or a distributer. The magneto is driven through gears by the engine shaft and the whole may be connected as a unit, affording the utmost simplicity and compactness. The spark from the power driven magneto occurs at exactly the time that the explosion is desired and being hotter than the ordinary battery jump spark, causes a more complete as well as a quicker ignition with a resulting greater efficiency in the engine or more power delivered to the shaft.

But this is not the only advantage, the spark being almost instantaneous, and its point of generation being in synchronism with the speed of rotation, there is practically no limit to the speed, from the electrical point of view, at which the engine may be operated. There are variations in this construction, for instance, one magneto has a stationary armature, and between the armature and the pole faces is an oscillating iron shield, which, varying the flux between the poles, causes the generating of electro-motive force as before. While electricity has made the light gas engine possible, the refinement in the form of the high tension magneto has permitted improvements which were undreamed a decade ago, and these improvements have made the airship a reality.

PERSONALS.

E. J. de Sabla is making an extensive tour of Europe with his family.

A. R. Maujer, associate editor of "Power," of New York, is a San Francisco visitor.

Leon Bly, secretary of the Tehama Light & Power Company of Red Bluff, recently visited San Francisco.

Charles L. Stamps, Jr., a gas appliance manufacturer of Los Angeles, recently paid a visit to San Francisco.

John A. Shackleford has been elected president of Tacoma Railway and Power Company of Tacoma, Wash.

August Herrmann, who is interested in the Cincinnati Gas, Coal, Coke & Mining Company, is a San Francisco visitor.

F. F. Skeel, manager of Crouse-Hinds Company, is at Los Angeles for a week and will return East via San Francisco.

W. S. Heger, manager for the Allis-Chalmers Company in California, spent the past week at his Los Angeles office.

H. R. Noack, general manager of Pierson, Roeding & Co., is making a trip to New York and the Eastern manufacturing centers.

A M. Erwin, treasurer of the Westinghouse Electric & Manufacturing Company, has arrived at the San Francisco office from Pittsburg.

H. F. Dodge, division commercial superintendent of the Western Union Telegraph Company, has returned to his San Francisco office, after a tour of the Pacific Northwest.

Wallace W. Briggs, manager of the Westinghouse Electric & Manufacturing Company's district agency with headquarters at San Francisco, left last week for East Pittsburg.

C. D. Heise, of the sales department of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco after paying a visit to the works at East Pittsbrug.

Rudolph W. Van Norden is in the mountains of Lake County, California, on engineering work for the Clear Lake Power & Irrigation Company, for which he is consulting engineer.

A. A. Serva, sales manager of the Fort Wayne Electric Works, is at San Francisco, where he will spend some time with George I. Kinney, manager of the Pacific Coast branch office.

H. A. Lardner, manager of the Pacific Coast office of J. G. White Co., of New York, spent the past week in Southern California looking over the electrical construction work which the firm has in hand.

F. I. Annabel, formerly general superintendent of the Arizona and Swansea Railroad at Swansea, Ariz., has been appointed assistant superintendent of the northern division of the Pacific Electric Railway at Los Angeles.

Rodrick J. McHugh, formerly a branch manager of the Kellogg Switchboard & Supply Company, and later connected with the Arizona Telephone Company, was at Los Angeles last week. He now represents the Hughes Electric Heating Company on the Pacific Coast.

George R. Field, assistant general manager of the Great Western Power Company, has resigned, to take effect July 1. This follows the resignation of H. H. Sinclair as general manager of the same company, announced in a recent issue. Mr. Field having decided on this action at the same time. Mr. Sinclair and Mr. Field will probably retain a connection with the company in its large construction work contemplated on the Feather River, as the plans for this work were prepared by them, and it is understood to be the desire of the officials of the company that the actual work should be done under their direction. In addition to his other duties Mr. Field has had the general direction of the construction work of the company for the past two years, including the large concrete dam at Big Bend, Feather River, finished last November.

Newly elected members of the American Institute of Electrical Engineers include H. A. Barre, electrical engineer, Electric Operating Construction Co., Los Angeles, Cal.; H. S. Buchanan, station superintendent, Telluride Power Co., Provo, Utah; J. B. Butler, construction engineer, Northern California Power Co., Balls Ferry, Cal.; J. E. N. Carpenter, electrician. Pacific Gas & Electric Co., Sacramento, Cal.; W. C. Campbell, engineering department, General Electric Co., San Francisco, Cal.; W. O. Crooks, electrician, Northwestern Improvement Co., Cle Elum, Wash.; I. F. Dix, division plant engineer, Pacific T. & T. Co., Los Angeles, Cal.; B. G. Flaherty, electrician, Northwestern Improvement Co., Cle Elum, Wash.; F. H. Fowler, assistant chief engineer, U. S. Forest Service, San Francisco, Cal.; J. A. Gregory, manager record department, Home Telephone Co., Los Angeles, Cal.; J. A. Harris, chief operator Great Western Power Co., Oakland, Cal.; O. B. Helt, sales agent, General Electric Co., Portland, Ore.; John Hood, engineering department, General Electric Co., San Francisco, Cal.; J. M. Hungate, superintendent of sub-stations Spokane & Inland Emprise Railway Co., Spokane, Wash.; J. C. Jones, salesman Westinghouse Electric & Manufacturing Co., Salt Lake City, Utah; S. J. Keese, district manager, Westinghouse Electric & Manufacturing Co., Los Angeles, Cal.; G. L. Larson, assistant professor of mechanical engineering, University of Idaho, Moscow, Idaho; J. S. La Sha, chief of engineering department, San Diego Consolidated Gas & Electric Co., San Diego, Cal.; R. G. Littler, manager West Coast Engineering Co., Portland, Ore.; Wm. Maddock, superintendent of electrical distribution, Los Angeles Gas & Electric Corporation, Los Angeles, Cal.; W. L. Miller, superintendent United Missouri River Power Co., Helena, Mont.; A. A. R. Perrine, instructor of electrical engineering, Montana State College, Bozeman, Mont.; F. C. Piatt, underground electric distribution department, Oakland Gas, Light & Heat Co., Oakland, Cal.; C. O. Smith, station operator, Los Angeles Pacific Co., Los Angeles, Cal.; J. L. R. Wood, manager Albany Iron Works, Albany, Ore.; D. D. Wright, salesman, Wagner Electric Manufacturing Co., San Francisco, Cal

TRADE NOTES.

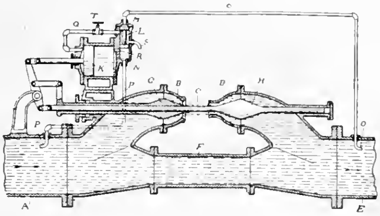
The Fort Wayne Electric Works secured the contract for the transformer work in connection with the large hydroelectric development for the city of Tacoma, Wash., on the Nisqually River. Both power-station and substation transformers for the 30,000-kw. installation are included in the contract.

The Pelton Water Wheel Company of San Francisco has been awarded the contract for the impulse wheels for new installation of the Mother Lode Mining Company in British Columbia. About nine wheels, varying from 10 h.p. up to 400 h.p. each, will be installed to operate under an effective head of about 640 feet. Each generator air compressor and other unit in connection with the running works, will have its individual water wheel, adapted to the class of service desired.

The General Electric Company recently issued bulletins describing its Type F. Oil Switches. Bulletin No. 4821 deals with switches for use on circuits, the voltage of which does not exceed 15,000, and No. 4823 refers to switches designed for voltages of from 22,000 to 110,000. These switches are adapted to the requirements of modern stations employing these switches. They are top connected and are, therefore, adapted to overhead station wiring. There is a double break for each pole and the break takes place in oil. These switches can be fitted with either hand operated or solenoid operated mechanism.

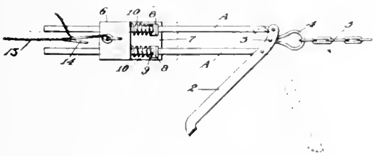
PATENTS

991,624. Safety Device for Hydraulic Systems. Leopold M. Karnasch, San Francisco, Cal. A safety device for a pipe line comprising a by-pass for a short length of the line, the by-pass being divided into two sections, the ends of the sections



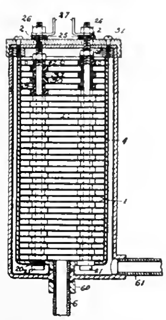
being provided with nozzles, spaced apart and facing each other and needle valves in the nozzles operated by a variation in pressure in the pipe line to varry the size of the nozzle openings.

991,965. Wire-Tightener. Jesse Flint, Cool, Cal., assignor of one-half to George E. Lukens, East Auburn, Cal. The combination in a wire tightener, of a lever having a fulcrum, two rods pivoted to the lever on each side of the fulcrum, a carriage slidable on the rods, said carriage comprising a plate



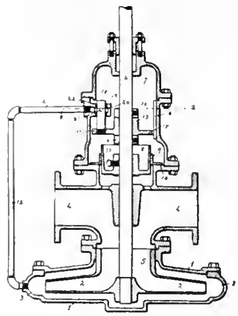
with bent perforated flanges through which the rods pass, and said plate having a perforated platform extension, perforated gripping bars through which said rods pass, said bars loosely fitting the perforations in said platform extension, and springs acting against the carriage and gripping bars to prevent the latter gripping said rods on the return stroke.

991,877. Electrical Liquid-Heater. Andrew P. Nichols, Seattle, Wash., assignor to Central Manufacturing Company, Seattle, Wash. In an electric liquid heater, in combination,



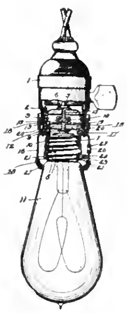
a superposed series of conductive plates spaced apart, and having an insulating covering upon one side, said plates being arranged with like surfaces of successive plates opposed and having openings permitting passage of the liquid successively through the spaces between said plates, and means for connecting alternate plates with opposite poles of an electric generator.

992,005. Balancing Device for Thrust-Bearings. Carl A. Krogh, San Francisco, Cal. In a centrifugal pump, in combination with the impeller and its shaft, a pressure chamber surrounding the shaft, a hollow piston adjustably connected to said shaft and having one side exposed to the pressure in said chamber and on its other side to the suction of the



pump, and a surrounding packing ring resting upon a seat in said chamber, a loose collar mounted on said shaft above said piston, provided with a projecting arm and a valve in said chamber mounted on said arm and moved by the longitudinal movement of said shaft, and operative to open and close a communication between said chamber and the source of pressure.

992,084. Incandescent Lamp Lock. Charles W. Trulock, Los Angeles, Cal. An incandescent lamp lock comprising a swivel plug socket consisting of a plug member and a socket member each having a central terminal, lugs carried by said socket member, said plug member being adapted to be connected with a lamp socket, an incandescent lamp, adapted to be



connected with said locket member, a collar having connection at one end with said lamp socket and adapted to conceal said adapter, and means carried by said collar adapted to be actuated by a key to engage one of said lugs to hold said socket member stationary to enable the connection with or removal of the incandescent lamp socket from said socket member.

INDUSTRIAL

SWITCHBOARD FREQUENCY METERS.

The accurate adjustment of frequency is of great economic importance, and, therefore, it is highly desirable to be able to measure frequency directly. There are several forms of frequency meters on the market, but none meets all of the requirements of general switchboard service. The Weston Electrical Instrument Company of Newark, N. J., has developed a new type of frequency meter which they claim meets every requirement of switchboard service.

Fig. 1. Front View Frequency Meter.

The device consists of a combination of resistors and reactors connected to a differential meter which is arranged to indicate frequency. The circuits are shown in Fig. 3. They form a sort of Wheatstone bridge arrangement. One side of the bridge consists of a resistor, the coils of the instrument and a reactor all in series, and the other side consists of a reactor and resistor. The whole combination is connected in series with a reactor across the line, and then a short connection, A, is made from a point between the two coils and a point between the resistor and the reactor on the other side of the bridge.

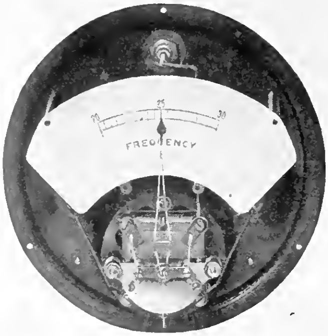


Fig. 2. Interior View Frequency Meter.

The constants of the circuits are so adjusted that there will be no difference of potential across the lead A at normal frequency, then when the frequency departs from normal, the reactance will change and cause more current to be established through one coil and less through the other, the difference being carried by the lead A.

The indicating instrument is a soft-iron type meter with two field coils. These coils are wound flat and slipped one inside the other with their magnetic axes in space quadrature. The working field is the resultant of these two quad-

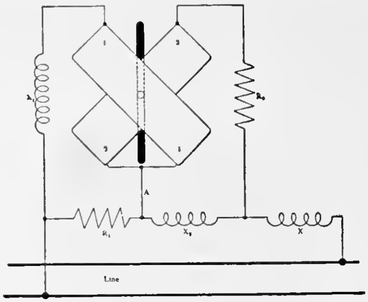


Fig. 3. Circuit Diagram.

rature components, and, therefore, its space position depends entirely upon the relative value of the two component fields. Within the field coils there is situated an iron needle mounted on a pivoted staff and left perfectly free to rotate. This needle always aligns itself with the resultant field, and since the resultant field occupies a definite position for every combination of current values in the field coils, and since the division of current between the coils depends upon the frequency, each position of the needle corresponds to a given frequency and the scale may be calibrated to read directly in cycles per second.

By properly choosing the constants of the circuits and suitably designing the indicating instrument, the scale has been rendered uniform and open throughout its entire range and therefore readings may be made from a distance based upon the general position of the pointer with reference to the scale as a whole.

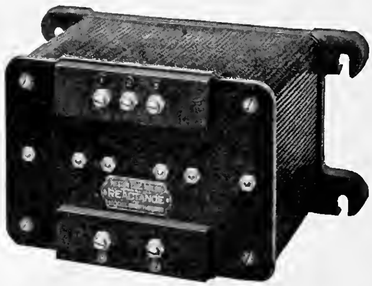


Fig. 4. Auxiliary Box.

A superficial consideration of the theory of this instrument will show that the accuracy is largely dependent upon the proper performance of the reactors. The reactors and resistors, which are mounted together in one auxiliary box, are shown in Fig. 5. As may be seen, the general appearance of the construction is very similar to that of a core-type transformer.

The core material is a special alloy steel having a low hysteretic constant and high permeability. The laminations are made extremely thin and are thoroughly insulated to reduce eddy currents to a minimum. They are firmly bolted together to prevent vibration and loosening of the parts and therewith avoid changes in magnetic reluctance. The air gaps, of which there are two, are made easily and accurately adjustable and by virtue of their location, one in the middle of each coil they are shielded by the conductor turns and thus the formation of stray or leakage fields is prevented. Stray fields such as are formed around unshielded air gaps are very objectionable since they vary with the voltage. In the present instance such troubles are practically nil; for example, this frequency meter will indicate the correct value of frequnecy within 1½ per cent between 75 and 150 volts.

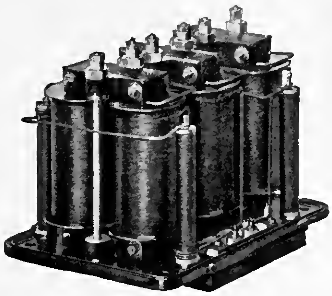


Fig. 5. Reactors and Resistors.

The indications are also independent of any wave distortion which ordinarily occurs in practice, the higher harmonics being damped out by the reactor in series with the device.

The movable system is extremely light and perfectly damped; therefore, it is sensitive and dead beat and will follow accurately every change in frequency.

WOOD STRAIN INSULATORS FOR ELECTRIC LIGHT AND POWER LINE CONSTRUCTION.

It appears to be a prevailing opinion with many electrical construction men that wood strain insulators are properly used only in street railway installations. That this impression is incorrect is evidenced by the volume of orders that is being placed by the manufacturers by exclusive electric lighting and power companies, for strain insulators of this type.

Wood strain insulators are cheaper than composition forms, and are less effected by the action of the weather. Unlike porcelain insulators they are not brittle and they have greater sparking distances. They can be used in guy wires, at dead ends of conductors and in practically any application for which porcelain and composition insulators have been used heretofore.

One feature of the wood strain insulator that renders it particularly desirable for insertion in existing guys is that it can be cut in a guy wire without its being necessary to splice in an additional length of wire. The reason for this is that the wood insulator is relatively long and when one is inserted in a guy wire sufficient slack will result therefrom to form the servings.

Westinghouse wood strain insulators are constructed of specially selected hickory which is impregnated with a waterproof insulating compound and then given two coats of varnish, each of which is baked on. The caps are malleable mild steel pressed around the conical ends of the staffs with powerful hydraulic presses. It is interesting to note that there is a certain angle of pitch for each diameter of insulator that gives maximum holding power. The greater the angle the more the metal will be disturbed in swaging it on the wooden cone and the more it is deformed the weaker it will be. On the other hand, the smaller the angle of pitch the greater is its wedge action tending to open the cap after it has been given a conical form.

Tests demonstrate that when stressed to destruction, 95 per cent of the Westinghouse wood strain insulators will break in the wood. The caps seldom fail first. The average ultimate tensile strength of the 1-inch diameter insulator is 7000 pounds and of the 1¼-inch diameter insulator, 8000 pounds. The average ultimate dielectric strength of insulators measuring 5 in. along the staff between the caps is over 50,000 volts when tested dry. This seemingly excessive insulation is advisable in order that there will be an adequate factor of safety for pressures of 600 volts when the insulation is dirty and wet. Wood strain insulators having an insulating distance of 12 inches are recommended for working voltages of 1000 to 2000. Wood strain insulators having lengths up to 48 inches are manufactured by the Westinghouse Company.

Metal caps, carrying eyes, clevises, or tapped bosses can be furnished. Caps of the same style can be furnished on each of the ends or a cap of one style can be furnished on one end and a cap of a different style on the other end.

A CENTRAL MINE POWER PLANT.

The Victor-American Fuel Company, who own one of the most up-to-date and modern coal mining plants in the Southwest, has been operating steam plants at three of its coal properties near Gallup, New Mexico. A short time ago, it decided to install a central turbine plant, and transmit power from this to its other properties. To this end, the company constructed a fireproof power house built of brick, with steel supported roof in which it is installing one 300 h.p. water tube boiler, and three 100 h.p. marine boilers with Illinois stokers, space being left for additional boilers to be installed later. Steel coal bunkers are provided which receive coal from a table about 200 feet away. The ashes from each boiler fire pot are emptied into a special car underneath the boilers and these cars are run out and the ashes emptied into a pit from which they are conveyed by an aerial tramway to an ash dumping ground some 2000 ft. away.

In the generator room, the present installation will consist of 2 ATB 500 kw. 2300 volt three-phase General Electric horizontal condensing steam turbines operating at a speed of 3600 r.p.m and a frequency of 60 cycles, space being left for two additional units. The exciters will consist of two continuous current 15 kw. 125 volt General Electric condensing turbines operating at a speed of 4500 r.p.m.

The switchboard was purchased from the General Electric Company and will have Vermont blue marble panels and standard finished instruments. It will consist of two 15 kw. d. c. exciter panels, two 500 kw. a. c. turbine panels, and four a. c. single circuit feeder panels, with all necessary instruments, including wattmeters, synchronism indicator and voltage regulator.

There are at present four feeder circuits radiating from the power house. One circuit goes to the Heaton mine, about 1¼ miles distant, where about 300 kw. in motors are installed; another runs in the opposite direction to the company's Navajo mine, where it has approximately 600 kw. in motors; the third circuit goes to the Bartlett mine, about 1½ miles away, where 200 kw. in motors are installed; the fourth circuit goes to the town of Gallup, five or six miles away, where the electricity will be used for lighting and power. A voltage of 6600 was decided upon as a suitable potential for transmission as some of the developments were situated four t. six miles from the plant. All the circuits are protected by General Electric aluminum cell lighting arresters.

NEWS NOTES

INCORPORATIONS.

LAKEPORT, CAL.—The Mt. Konocti Light & Power Company has been incorporated by J. A. Foster, J. L. Davis and J. Hastings.

SAN FRANCISCO, CAL.—The National Illuminating Company has been incorporated for $1,000,000 by S. J. Kenworthy, R. M. Cole, R. M. Barr, G. A. and W. E. Bartlett.

EL MONTE, CAL.—The El Monte Light & Water Company has been incorporated. Directors: A. F. Snell, I. T. Baker, G. H. Coffin, S. Shirpser and M. Kauffman. Capital stock, $25,000. Subscribed, $50.

LOS ANGELES, CAL.—The Central Counties Gas Company of California has been incorporated. Directors: C. S. S. Forney, W. S. McFarland, H. W. Ritz, F. N. Hawes, L. O. Adams, F. E. Miller, R. B. Wheeler, O. B. Hinsdale and J. L. McCalley. Capital stock, $1,000,000. Subscribed, $9.

ILLUMINATION.

ALAMEDA, CAL.—Steps are now being taken to call a bond election in this city which will include $125,000 for the electric light plant.

MADRAS, ORE.—The City Council has passed an ordinance authorizing A. E. Hammond to construct and operate an electric light and power plant in the city of Madras.

LEAVENWORTH, WASH.—An ordinance granting to the Tumwater Light & Water Company a 43-year franchise on all the streets and alleys of this town is now before the City Council.

WAITSBURG, WASH.—The Council has passed an ordinance granting to the Waitsburg Electric Light Company the right to maintain electric light and power lines in the city of Waitsburg.

LOS ANGELES, CAL.—The Board of Supervisors has voted to accept the bid of the Thomas Day Company of San Francisco of $13,360.26 for furnishing electrical fixtures for lighting the Hall of Records.

LOS ANGELES, CAL.—The High School Board of Los Angeles is receiving sealed bids for furnishing labor and material necessary for the electrical work of the Mechanics Building, Hollywood High School.

SEATTLE, WASH.—Mayor George W. Dilling has signed a bill passed authorizing an expenditure of $75,000 for the construction and maintenance of a new power house on Lake Union at the foot of Nelson place.

LEAVENWORTH, WASH.—The Snow Creek Water Company, recently organized and now having the construction of a water system under way, has made application for a franchise to furnish electric current for light and power purposes.

GOLDENDALE, WASH.—The Pacific States Electric Company of Portland has purchased the electric light plant of this city from H. W. Fellows. The price paid was $55,000 cash. The system will be extended and improved by the new owners this spring.

ROSEBURG, ORE.—Fire last week destroyed the Winchester plant of the Roseburg Water & Light Company. The loss is given at $50,000 with $12,000 insurance. Kendall Bros., who own the plant, also maintain a small auxiliary plant in the south part of Roseburg. This will furnish the city with water and light until the plant can be repaired.

LEWISTON, IDAHO.—The franchise sought by the Lewiston Clarkston Improvement Company to supply this city with electrical current for heating, lighting and power purposes has been passed by the City Council, five members voting in favor of the franchise.

TURLOCK, CAL.—Engineer Steele has presented to the City Trustees a written report as to the probable cost of the installation of a municipal gas plant. He advised the Trustees not to raise less than $50,000 for this purpose. He estimated that $35,000 would be sufficient to build a plant that would supply Turlock at the present time.

TRANSMISSION.

SALEM, ORE.—The City Council has voted to purchase the Salem Light & Water & Power Company's plant for approximately $370,000.

VANCOUVER, WASH.—Engineers of the Mount Hood Railway & Power Company are here completing arrangements for the construction of a substation.

PALO CEDRO, CAL.—The Northern California Power Company has built six miles of power lines, north, east, south and west, to accommodate these farmers.

REDDING, CAL.—C. W. Hill has given notice of the appropriation of 300 inches of water to be taken from Bear Creek to be used for the generation of electric power.

SONORA, CAL.—D. H. Steinmitz, general manager of the Standard Company of Sonora, and T. S. Bullock of the Sierra Railway Company have filed on 40,000 inches of water in the north fork of the Tuolumne River.

VANCOUVER, WASH.—The Mount Hood Railway & Power Company has been awarded the contract for furnishing electricity at the U. S. garrison. The other bidder was the Portland Railway, Light & Power Company.

COLUSA, CAL.—The service on the new 60,000 voltage line between this city and Marysville started this week and the service over the old line to Gridley is a thing of the past. The Gridley line will be used as a substitute in case the other line goes out.

SAND POINT, IDAHO.—The town of Hope, East Hope and Clarkfork are after electricity for power and light purposes and the Northern Idaho & Montana Power Company is making estimates upon the cost of extending its power line from here and if the business in sight will warrant the expenditure.

SAN FRANCISCO, CAL.—A local financial deal just announced is the sale of $1,000,000 worth of bonds by the Northern California Power Company to N. W. Halsey & Co. The company has an authorized issue of $10,000,000, of which but a small part has been put out. The income from the sale will be devoted to improvements and extensions. The terms of the sale have not been made public.

OROVILLE, CAL.—The Great Western Power Company is soon to start active work on the additional unit to the plant at Las Plumas. S. B. Hutchinson, local labor agent, has been instructed to secure a force of laborers. The men will be set to work building a road on the Las Plumas side of Feather River and erecting a number of cottages and storehouses. There are now four units at the plant and plans have been made for the addition of another unit.

TRANSPORTATION.

OAKLAND, CAL.—The Southern Pacific Company operated its first electric trains on the Alameda system on May 11.

LOS ANGELES, CAL.—The Board of Public Works is receiving sealed bids for furnishing to the city two miles of copper trolley wire.

CHICO, CAL.—The double track franchise on Main street desired by the Northern Electric Railway will be advertised for sale, June 6th having been set by the Board as the date for opening the bids.

SANTA CLARA, CAL.—Manager F. E. Chapin of the Peninsular Railroads states that the company intends to build an electric line from Santa Clara to Meridian Corners and that it will be but a very short time before they will have their plans in shape to ask for a franchise for such road.

CHICO, CAL.—J. B. Rowray, formerly connected with the Pacific Electric Railway Company at Los Angeles, has assumed his new duties with the Northern Electric Company, filling the vacancy caused by the resignation of Melville Dozier, assistant manager and engineer for the company. Rowray has gone over the road several times and is now familiar with it and has secured a general insight into local conditions. He will make his headquarters at Chico.

MONTEREY, CAL.—The Monterey & Pacific Grove Electric Railway will abandon its lines on Decatur street from Alvarado street to Pacific street and on Lighthouse avenue in front of the Presidio gate and run over a private right of way from the end of Alvarado street at the Custom House in a straight line along the Southern Pacific track to a point on its present line on Lighthouse avenue. This is announced by General Manager Davis, who says that a right of way over the Southern Pacific Railroad has been secured and that work on the new construction will commence at once.

LOS ANGELES, CAL.—Operation of the Los Angeles and Redondo Railway and the San Pedro narrow gauge line, as a portion of the southern division of the Pacific Electric Railway, was begun last week in accordance with a circular issued from the office of J. McMillan, general manager of the Pacific Electric. Tracks of the Los Angeles and Redondo and San Pedro line will be broad-gauged, the time for beginning the change not having been announced. Three new officials of divisions of the Pacific Electric, appointed recently, were installed in office, as follows: W. T. Maddox, superintendent of the southern division, succeeding Thomas McCaffery, resigned; J. C. McPherson, superintendent of the northern division, succeeding J. B. Rowray, resigned; F. L. Annable, assistant superintendent of the northern division, succeeding J. C. McPherson, resigned. Offices of the superintendents will be in the Pacific Electric building. Those of the assistant superintendent will be in Pasadena.

TELEGRAPH AND TELEPHONE.

OAKLAND, ORE.—Plans have been adopted for the rebuilding and improvement of the local telephone system.

EUREKA, CAL.—According to a report from Orleans the forest service has surveyed the line for a telephone service as far down the Klamath River as Bluff Creek.

DAVENPORT, WASH.—The lines of the local and long distance telephone company have been sold to the Washington Consolidated Telephone & Telegraph Company of Spokane, at $10,000.

WENATCHEE, WASH.—H. W. Boetzkes of Chelan has filed an application for a franchise to construct a pole line for telephone wires extending from Chelan 14 miles over county roads. It is rumored that the franchise is being secured for the Ellingsworths, who are developing irrigation projects where the proposed line will extend.

SPOKANE, WASH.—The Pacific Telephone & Telegraph Company has made application for a permit for the new exchange which is being erected at the corner of Second avenue and Stevens street.

SAN FRANCISCO, CAL.—The new wage agreement of the electrical workers with the Pacific Telephone & Telegraph Company has been accepted dating May 1, and embracing the States of Washington, Oregon, California and Nevada. The electricians affected will receive an increase in wages amounting to 25 per cent and double time for all overtime.

WATERWORKS.

CORNING, CAL.—Bids for the construction of the new water system for Corning have been opened by the Board of Trustees. The contract was awarded to the Braun, Williams & Russell Company for $40,500.

SAN DIEGO, CAL.—Mayor Wadham in his message to the City Council recommended that the city immediately begin consideration of and preparation for the purchase of the water system of the Southern California Mountain Water Company.

CENTRALIA, WASH.—The Washington-Oregon Corporation, the holding company of the Twin City Light & Traction Company, has presented a franchise ordinance to the City Council for passage which grants to the corporation a 50-year water franchise.

EUREKA, CAL.—W. C. Corbaley, superintendent of the Eureka Water Company, has left for San Francisco where he will secure bids and probably arrange a contract for the building of a water tower in the southern part of the city. The tower is to be 85 feet high and will be built on ground 15 feet higher than the present tanks and will cost at least $30,000.

NEWMAN, CAL.—The Newman Waterworks Company announces its intention to make a number of important improvements in its system at once. The distribution facilities will be bettered by the laying of a new four-inch main through the Postoffice block, from Fresno street to Merced, and a three-inch main from Kern to Yolo street. The total cost will be about $3000.

OAKLAND, CAL.—W. F. Kelly, former general manager of the Oakland Traction Company and the Key Route systems, will become directing engineer and assistant general manager of the People's Water Company if Frank C. Havens, president of the water company, can induce him to accept the position. At the time he tendered his resignation as directing head of the traction lines of Oakland it was rumored that his severance of connections with the Smith interests was due to his close friendship with Havens. Both Messrs. Havens and Kelly decline to discuss the probable association of the latter with the People's Water Company, but both admitted that such an arrangement might be effected within a short time.

BAKERSFIELD, CAL.—C. B. Colby, one of the local oil men interested in the Western Water Company, which is to furnish water for drilling and domestic purposes to the West Side from wells near Rio Bravo, announces that the new company will supply Maricopa. A service line will be constructed from 110,000 barrel storage, to be erected at the Taft station, into the field and town of Maricopa. Work has been begun in putting down another well at Station 1 near Rio Bravo. Operations will be put forward as speedily as possible. Sixty-nine thousand feet of the 12-inch pipe for the main line have been ordered and it will require between 13 and 14 miles of a small sized pipe to install the first service lines. Mr. Colby declares that contracts are being signed up readily and the first capacity of 40,000 barrels will be disposed of long before the line is ready for service.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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TRINITY MINE HYDRO-ELECTRIC PLANT

BY J. W. SWAREN

The Trinity Gold Mining and Reduction Company have recently completed a hydroelectric plant remarkable for its simplicity. It was installed to supply power and light to the mill and cyanide plant erected by the same company. The engineering features are those incident to a rough, inaccessible country and the general design was to secure reliability and continuous operation.

Point of Intake

The plant is situated on Coffee creek, a tributary of the Trinity river, and about one mile from Carrville, taking water out of Coffee creek nearly two miles above the power house. Coffee creek rises in the extremely rough country where Scott mountains join the Salmon Alps. The flanks of the hills forming the watershed of Coffee creek are covered with a heavy growth of young timber, and since grazing has been perceptibly diminished under Forest Service administration, is rapidly becoming covered with an almost impenetrable undergrowth. Snow lays on the mountain tops almost the entire year, and this, combined with excellent cover on the slopes, insures a certain and rather even water supply.

This part of California has been, and still is a famous hydraulic mining section, several hydraulic mines still operating on Coffee creek, the tailings being discharged into the stream. For this reason it was not deemed advisable to build a permanent dam at the point of intake, as it would fill with detritus and become a menace. Instead a short concrete wing dam was thrown out from the bank at a point where solid rock was obtainable for foundations. A temporary dam of brush, cobble and bags is thrown across the stream in autumn when water begins to run low. When the spring freshets come, this dam and all impounded detritus is swept away, and the wing dam is relied on for diversion.

A rough screen, or rather grizzly, made from logs cut on the ground is placed over the intake to deflect heavy wash and protect the flume. The flume from intake to penstock is 9300 ft. long, 4 ft, wide and 34½ in. deep inside. For the first 1500 ft. after leaving the intake heavy work was encountered, the flume grade being blasted, and the ground having a natural slope of 45 degrees. Contour lines were followed closely and where a draw was crossed, a fill was made instead of trestle. Some trouble with slides was experienced when the first heavy snow was followed by a warm rain, but this had been anticipated. In no instance was a fill taken out and the only serious interruption during the past winter was when a tree fell across the flume, causing a shut down of six hours.

All timber for the flume, rough unplaned boards, was cut by the company, and the bents mortised in the company mill, but transported to the flume grade before framing. In building the flume, three gangs of men were worked. The first, under charge of an engineer, laid 2 in. x 8 in. stringers to grade; the second

Flume During Construction

framed and placed the bents and nailed them to the stringers; the third gang laid the floor and nailed the sides. The accompanying view of the flume gives an idea of the timber growth on the watershed.

The flume is laid with a grade of 10.5 ft. per mile, and when running three-fourths full, carries 3100 cu. ft. per minute with a velocity of 5 ft. per second. This amount of water is more than sufficient for the present load, but it is the intention to increase the mill capacity, requiring more power.

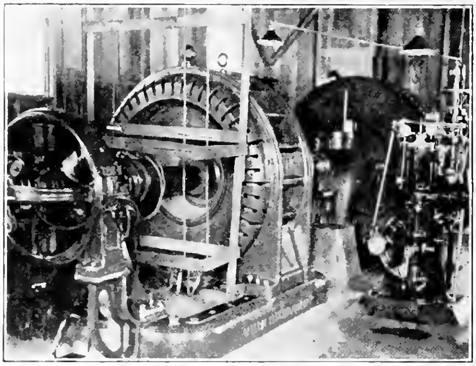
Both side and bottom opening gates are provided at various points along the flume, the type depending on the contour of the country. At the penstock the usual screens and waste flumes are installed. One turnout, as shown in the view, is installed about half way between the intake and penstock.

The pipe line is 500 ft. long, and leaves the penstock by a 6 ft. bell. It is 32 in. in diameter, No. 18 gauge steel for the first 250 ft. and narrows to 30 in., No. 14 gauge for the last half. Air valves are provided, but were frozen solid at the time of the writer's visit.

The static head at the wheel is 107 ft. Hendy hydraulic gates are installed between the pipe line and turbine. The pipe is laid in a trench the greater part of its length, and is anchored by earth tightly rammed. Due to the contour it was found expedient to ram the pipe from the bottom, instead of the top, as is the usual practice.

The wheel is a Francis turbine designed by O. C. Goeriz, built by the Joshua Henry Company, and runs 514 r.p.m. It is set on concrete foundations and the same foundations take the thrusts from the pipe line. The spiral casing is built from steel plates, riveted. This type of casing was adopted for ease of transportation and to insure ample strength for resisting strains from water hammer. Babbitted ring oiling bearings are used. The bearing projecting through the draft tube elbow is a ring oiling collar type bearing, to receive any unbalanced thrust from the runner. Discharge is made through 100 ft. of tailrace to Coffee creek, near its confluence with the Trinity river.

This turbine is fitted with the Voith type of control, a common method of regulation in Europe, but



Generating Unit

seldom encountered in American practice. In this type, the guide vanes are connected by links to a ring inside the casing. This ring, in turn, is actuated by two bell cranks, placed diametrically opposite, with their axes extending through the casing. To avoid obstructing the water passages, every guide vane has a pocket cast in it, completely embracing the link.

A Lombard type R governor is installed, and as this governor produces a rocking, or swinging, motion in its control member, it is connected directly to a shaft with cranks actuating those of the control ring. This obviates all lost motion by eliminating racks and gearing. Excellent speed regulation is obtained.

Direct connected by a flexible coupling, is a General Electric, 400 k.v.a. generator, wound for 4000 volts, three phase and 60 cycles. The pole line was designed for a 10 per cent drop, but as the original survey was not followed, a somewhat shorter route being taken, the generator is operated underexcited, generating at 3800 volts and connected straight to the line without transformers.

A two panel switchboard is installed, one panel for the generator, the other a line panel with the usual equipment. A Tirrel regulator is provided for voltage

regulation. Aluminum cell lightning arresters are placed inside the building, being connected to the line just inside the building wall.

The transmission line is 7600 ft. long, running over the floor of the Trinity Valley, and up the mountain side to the mine, crossing the river enroute. The line is No. 6 hard drawn copper, on brown porcelain insulators. One cross arm and the pole top are used forming a 48 in. triangle. The poles are 35 ft. long, cut on the ground, and cost 60 cents each, ready to set. Remarkable time was made in setting these poles, 63 in all, only 17 actual working hours being consumed, with a single pole gang of five men. No difficulty was experienced in digging the holes, an occasional boulder

Mill Interior

giving trouble in the valley, although not more than ten holes had to be shot. The river is crossed with a single span of 180 ft., single 50 ft. poles, double armed, being used.

At the mill a substation is installed. Three 125 k.w. 3600/440 volt General Electric transformers, connected in delta, reduce the voltage for mill and mine distribution. The incoming panel has an ammeter, voltmeter and automatic overload switch. Horn gap and aluminum cell lightning arresters are installed.

The distributing panel has six switches, controlling various light and power circuits. Two 5 kw. transformers, 440/110 volt are installed for lighting service. All wiring is carried in conduit, underground, between switchboard and transformers.

For operating drills in the mine, an Ingersoll compressor, belt driven by a 75 h.p. motor is installed.

At present mule trains are used to transport the ore from mine to crusher, a distance of 800 ft., but an electric locomotive will be installed in the near future.

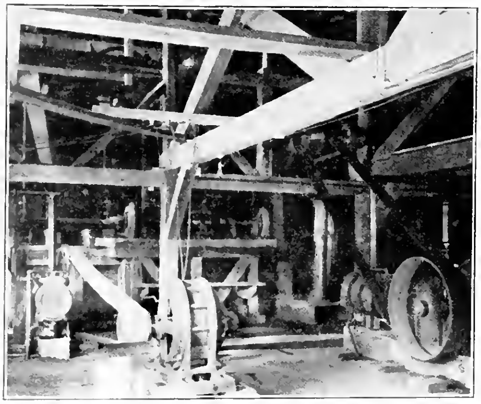
For crushing the ore before delivery to the bin's, two crushers set in tandem, and belt driven by a 50 h.p. General Electric motor, are installed.

Two 16 in. belt conveyors, one running from the crusher house to the mill and discharging on the second running at right angles, and over the tops of the bins, carry the ore from crusher to mill. These conveyors are driven by 5 h.p. Ideal motors, geared direct to each head pulley.

The stamps, of which there are forty, weighing 1050 lbs. and dropping 102 times a minute, are driven in two groups, by two General Electric 50 h.p. motors, set under the ore bin. A special belt tightener is used on this drive, and it is the practice here to start the stamps without hanging up. This is not conducive to good voltage and speed regulation at the power plant, although the results are not as bad as one would expect in starting a 50 h.p. motor against a 100 h.p. load and only 320 kw. behind it.

As the cyanide process of recovery is used exclusively, the usual equipment of concentrating machinery is not found.

To supply compressed air for the agitators and general use about the mill a 10x12 in. Ingersol-Rand



Motor Drive in Mill.

enclosed type compressor, is belt driven by a General Electric 20 h.p. motor.

There are four pulp thickeners, installed in two groups of two each, and each group driven by a 5 h.p. Ideal motor.

Two Oliver filters are installed to separate the cyanide solution carrying the gold and silver from the pulp. These machines and auxiliary equipment form the most interesting group in the whole installation.

To maintain the proper vacuum on the filters for moving the solution, an Oliver vacuum pump is installed. This pump is a horizontal single piston pump, iron fitted throughout, and without valves in the suction ports. It maintains a vacuum of 25 in. on the filters, with 27½ in. barometer reading, and operates on the wet vacuum principle. It has a displacement of 192 cu. ft. per minute when running 90 r.p.m.

A 10 h.p. General Electric motor drives a countershaft to which is belted the two filters and vacuum pump.

To maintain the pulp in the filter tanks at a proper consistency, two centrifugal pumps, mounted on the same subbase with a 5 h.p. Ideal motor, have their suction pipes connected to the filter tanks near the pulp level. The discharge of these pumps is returned through the bottom of the tank, terminating in a set of revolving arms similar to a Barker mill.

For handling the pregnant solutions during precipitation and returning them to the various stock

tanks, three 5x6 in. Deane triplex pumps, geared direct to 5 h.p. motors mounted on brackets are installed.

A Gould 5x6 in. triplex pump belt driven by a 10 h.p. motor is installed for a reserve unit to the solution pumps.

A 2 h.p. General Electric motor is installed in the assay office for driving the usual crushing machinery found there.

Arc lamps are installed for lighting the cyanide departments, while incandescent lights are used for lighting the stamps and rock crushing plant. In the mill a catenary suspension is employed to swing the rows of incandescent lamps from end to end of the building. Arc lamps are scattered about the workings and mine buildings for night illumination. In addition to lighting the offices and employees' cottages, a branch line is run to Carrville for lighting hotel and stores.

As might be expected in a plant having an almost exclusive induction motor load, great difficulty is experienced with low power factor. It is seldom that a power factor as good as .80 is obtained. To correct this difficulty, it is probable that a synchronous motor-generator set will be installed when electric locomotives are substituted for mules on the mine tram.

The entire plant was built under the direct supervision of Mr. David Goodale, manager of the Trinity Gold Mining and Reduction Company.

E. L. Beck, who is now mill superintendent, had charge of the hydraulic development.

B. B. Brown is electrical engineer for the Company and had charge of all electrical work and the installation of turbine and regulating apparatus.

The writer desires to extend his thanks to the management for the courtesies extended in the preparation of this article.

In closing, a singular coincidence that occurred in starting this plant might be related. When the power was turned on, not a single connection had to be changed, every motor revolving in the right direction.

GOVERNOR WILSON ON CORPORATIONS.

In the course of an address at the University of California last week Governor Wilson of New Jersey said:

"We are no longer afraid of our corporations as we used to be, because we are beginning to understand just what they are, and, to some extent, at any rate, just how they can be controlled and made to serve the purposes of our life without governing and controlling us. There was a time when our feeling about them was almost one of panic. We had undoubtedly ourselves created them. There was no disputing the fact that they were our creatures, made by laws which we ourselves had enacted, and had supposed we understood; but we stood amazed at the work of our own hands, and not only amazed, but awed and frightened. It is not a little amusing, as we look back upon our one-time state of mind in this matter, because, having created the corporations, we can certainly alter them if we please, and control them in any way that we choose. They are not actual persons. We made them—God did not—and we can alter the work of our own hands as we will."

The speaker then proceeded to define corporations, and said they possessed no inherent rights such as are possessed by the individual, but only such privileges as a collection of individual, forming a community, had conferred upon them. The granting of these privileges, he contended, carried the right of control.

In referring to public-service corporations, Governor Wilson said:

"Public-service corporations, such as railroads, street railways, gas companies and companies which supply electric light and power, are in a still larger sense public instrumentalities. Besides having the artificial advantages and powers conferred upon the ordinary corporation doing what we call private business they are in partnership with the Government in the laying of rails, the erection of poles and wires and the laying of conduits as the means of transmitting their service. They have had delegated to them the Government's right of eminent domain, the right to make partial use of public highways, to condemn rights of way across pieces of private property.

"Moreover, they are in a very interesting sense natural monopolies. They generally use the pieces of land and the roads and highways which are most convenient to their purposes, and most direct for effecting the communication which they wish to effect; and it is perfectly obvious that if other companies are allowed to compete with them, there is a very wasteful duplication in outlay and equipment. So that competition generally results in an eventual combination of the competing companies and the necessity to charge a price on what they supply that will pay the interest on twice as great an investment as was really necessary for the service."

Governor Wilson then went on to discuss the difficulties that had beset the representatives of corporations and of the Government in trying to meet on a common ground to adjust the relations of the two. In this connection he said:

"The real difficulty in the management of our corporations in recent years has been the wrong point of view of those who were in control of them. They did not recognize that they were public trustees. They acted as if they were conducting their own private business. Let them change their point of view, and there is no problem to solve. There is no legislation necessary if they will but regard themselves as trustees of the common interest, bound by considerations not private, but public, in the conduct of their business."

In concluding the speaker said: "I think that the spirit of the age is slowly changing. The time of contest and vituperation and mutual abuse and misunderstanding is passing away. It is beginning to be recognized that those who are leading the reform movement of the age are leading it in all sincerity and genuine public spirit. Men of business are waking, to look about them upon the real facts and to make statesmen of themselves and public men are going half way to meet them in this new temper and purpose of theirs. We shall yet see a day of happy accommodation and of established justice."

TEST OF A HYDRAULIC RAM.[1]

BY G. J. DAVIS, JR. AND D. P. DALE,

The hydraulic ram was invented by John Whitehurst in 1772 and in 1796 Joseph Montgolfier improved it by making its action automatic. Since the latter date no important improvements have been made in its design.

Hydraulic rams have come into extensive use for pumping small amounts of water to isolated dwellings, hotels and other buildings situated near small falls, but it was not thought practicable to build and operate large rams until 1895, when Professor D. W. Mead designed and built a ram for supplying the city of West Dundee, Ill., with water. This ram had a drive pipe 10 in. in diameter and 2,200 ft. long and operated under a supply head of 43 ft. This demonstration of the practicability of large rams has led to their adoption in many places for pumping the water-supplies of small cities and irrigation projects.

On account of its entering into competition with other types of pumping machinery in moderate sized installations, it is becoming important to have more precise knowledge concerning the principles of design and of operation of the ram. During 1907 an investigation of the hydraulic ram was made in the Hydraulic Laboratory of the University of Wisconsin by L. F. Harza. In his investigation theoretical formulas accounting for the action of the ram were derived and checked by experiment, thus demonstrating the practicability by rationally designing hydraulic rams for any given working conditions.

In the usual installation a ram would not be specially designed for the conditions under which it is to operate, but one, or a battery of rams, of some commercial make would be selected. In order to make a wise selection it is necessary to know the characteristics of the various types of rams and the proper conditions for their operation. In determining these characteristics there are many practical problems which need to be solved experimentally. A few of them are listed below:

1. What is the effect of variations in the size of the air chamber?
2. What amount of water should be kept in the air chamber?
3. What is the best rate of closure for the waste valve?
4. What should be the range of movement of the waste valve?
5. What is the best type of waste valve?
6. What is the best type of check valve?
7. What is the proper proportion between the check valve area and the diameter of the drive pipe?
8. What diameter of drive pipe is best under various conditions of operation and installation?
9. What is the best length of drive pipe to use under given conditions as to supply and discharge heads?
10. What rate of stroke is best for given conditions of supply and discharge heads and length of drive pipe?

Theory of the Hydraulic Ram.

Any hydraulic ram consists essentially of three groups of parts as shown in Fig. 1: A supply tank, drive pipe and waste valve, a check valve and air chamber, and a discharge pipe and reservoir.

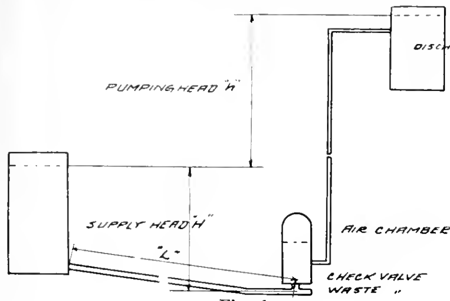


Fig. 1.

Nomenclature.—The following symbols will be used throughout this discussion:

H = head of supply tank on waste valve.
h = head of discharge reservoir on supply tank.
Q = rate of wasting water, pounds per minute.
q = rate of pumping water, pounds per minute.
r = rate of strokes, number per minute.
E = efficiency, per cent.

Manner of Working.—Let us assume the waste valve in Fig. 1 to be open. Due to gravity, water flows down the drive pipe with an accelerated velocity and makes its exit through the valve. This valve is so constructed that when the velocity of the water reaches a certain point, it will close suddenly. The result is a water hammer; the pressure in the pipe rises, forces open the check valve, and water enters the air chamber. It continues to enter until that pressure is relieved and equilibrium is established. Thereupon the check valve closes, the waste valve opens, and another cycle begins. Water has been forced into the air chamber against a high head; the air has a cushioning effect and produces a nearly uniform pressure in the discharge pipe. As the velocity of water into the air chamber is gradually extinguished, the pressure on the valve falls until it is equal to the pumping head. The water is now in a slightly compressed condition, and the walls of the pipe are distended. Such a condition is obviously unstable. The resulting contraction of the pipe and expansion of the water cause a flow back into the supply tank. The momentum of the resurge sets up a wave of rarefaction which reduces the pressure and opens the waste valve, thus starting another cycle. Were the waste valve to remain closed tightly, waves of compression and rarefaction would occur until friction damped out the accumulated energy.

Apparatus and Method.

The experiments were designed primarily for the purpose of ascertaining the effect of length of drive pipe on the efficiency and capacity of the ram.

The method outlined was to vary one factor while all the others are kept constant, and to vary in turn r, h, H, and L. It was believed that some of the runs could be omitted when the laws of variation were established. It was proposed to cover L at 20, 40 and 60 ft.; H at 4, 6, 8, and 10 ft.; and h and r throughout the range of which the machine was capable.

The apparatus consisted of a Columbia hydraulic

[1] The Wisconsin Engineer.

ram No. 195, cylindrical steel tanks for supply, discharge and waste, and a Crosby water gauge for registering h. The ram is 44 in. high and weighs 600 lb. The tanks are those regularly used in the hydraulic laboratory, and are fitted with calibrated glass gauges. The drive pipe is 62.4 ft. long, is 4½ in. inside diameter, and has a bellmouth fitted on the end to reduce entrance loss of head.

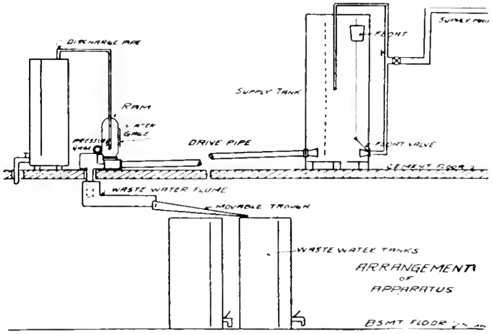


Fig. 2.

The supply head is fixed by the length of the wire joining the float in the supply tank to the arm of the float valve. Valves in the supply mains are set to give approximately the desired flow; the float valve takes care of minor fluctuations in supply and demand, and thus maintains a nearly constant H. In order not to introduce air into the drive pipe, and thus lose by air cushioning the water hammer effect, the ends of all pipes are placed well under water. The tension in a spring on the waste valve regulates r. A set screw device is used to fix this tension and thereby to govern r, the factor most often changed.

Two formulas for efficiency are in use:

Rankine, $E = qh \div QH$.

D'Aubisson, $E = q(H + h) \div (Q + q)H$.

Rankine's formula is used in these experiments.

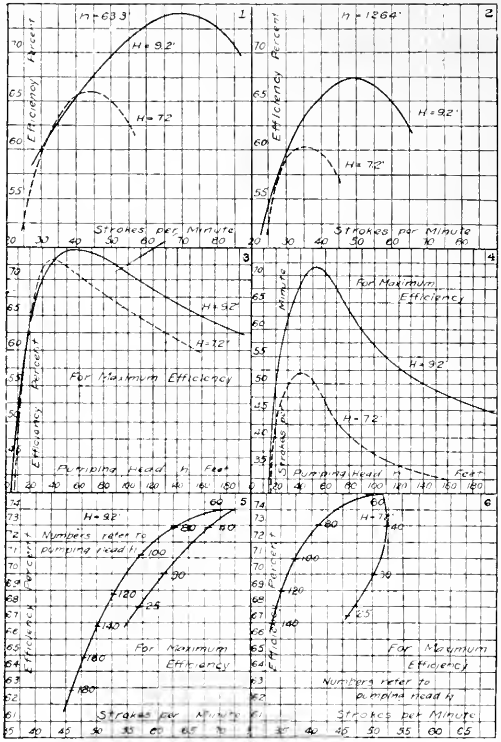
Discussion of Results.

The results of the experiments are shown in 140 curves, some typical ones of which are here given. The following outline shows the factors involved:

FACTORS INVOLVED IN CURVES.

Set of Curves	Variables	Constants	Remarks
1.........	E, r	L, H, h	h = 63′
2.........	E, r	L, H, h	h = 126′
3.........	E, h	L, H	For Maximum Efficiency.
4.........	r, h	L, H	" " "
5.........	E, r, h	L, H	H = 9.2′
6.........	E, r, h	L, H	H = 7.2′
7.........	r, q and r, Q	L, H, h	h = 63′
8.........	r, q and r, Q	L, H, h	h = 126′
9.........	Q, h	L, H, r	
10.........	q, h	L, H, r	
11.........	q, Q	L, H, r	H = 9.2′
12.........	q, Q	L, H, r	H = 7.2′

Set 1 shows the variation in efficiency with rate of strokes, H and h constant. E increases with r for a period and then falls off. Twelve such E—r curves were plotted with H = 9.2 ft., h varying from 24 to 186 ft. Of these, the full line curves of sets 1 and 2 are examples, viz., when h = 63.3 ft. and when h = 126.4 ft. The dashed curves are the corresponding ones for H = 7.2 ft. It may be observed that efficiencies are lower with the lower supply head. The curves for all pumping heads are similar and resemble parabolas.

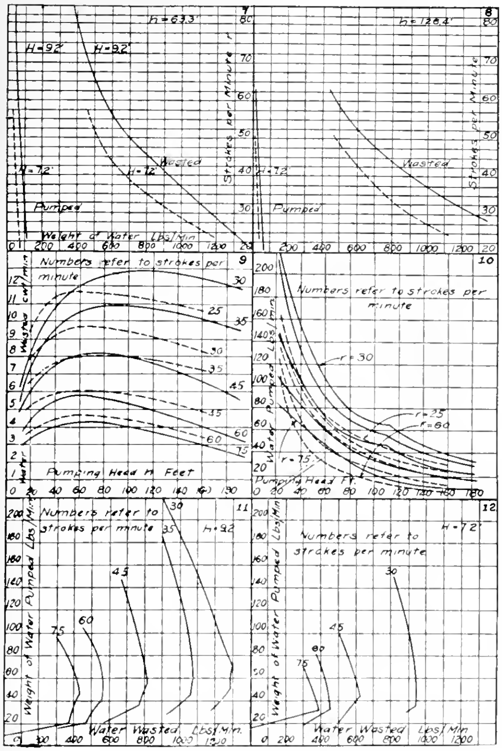


Curves 1-6.

Under the higher heads the range of rate of strokes is smaller, and the range of efficiencies is larger. This variation gives a more sharply defined maximum point to the curves for higher heads. It can be noted that the maximum point in the E — r curves as h changes from 24 ft. to 186 ft., rises for a time, and then gradually decreases. This rise and fall in maximum efficiency as h increases can be seen to better advantage in curve 3. It may also be noted that the maximum point moves simultaneously to the right, and then returns. This rise and fall in the rate of strokes for maximum efficiency can be seen in curve 4.

Curve 5 shows the simultaneous values of three variables: rate of strokes, pumping head, and maximum efficiency for that pumping head. It combines (3) and (4) by eliminating h. Suppose we have a fall of 9.2 ft., and wish to pump water to a height of 100 ft. Curve 5 shows that the maximum efficiency of 73 per cent will be secured by setting the machine to run at 63 strokes per minute. Curve 6 shows the relations existing under the condition H = 7.2 ft. When the series of experiments are finished, a number of curves similar to (5) may be plotted on one sheet, and will show for any combination of values of H and h within the range of the machine, the maximum efficiency that can be secured, and also what rate of strokes to use to secure the same.

The curves for Q (6, 7,) show that Q and r vary inversely. More water is wasted when the strokes are longer although there are fewer of them because the



Curve 7-12.

rapid increase in velocity acquired in the longer strokes more than offsets the effect of fewer strokes.

By curve 9 it may be seen that with r constant, as h increases, Q increases up to a certain point, and then decreases. By curve 10 it appears that q decreases always as h increases.

This constant decrease of q, and rise and fall of Q, as h increases, is shown in curves 11 and 12 for the different values of r.

Later experiments by A. E. May and H. N. Brue show the following results, when $L = 42$ ft. as compared to those obtained when $L = 62$ ft.:

The range of r^1 (where r^1 = rate of strokes for maximum efficiency as in set 4) is about twice as great. The range of efficiencies is also nearly twice as great. In order therefore to get good efficiencies with the short drive pipe, more care must be used in the adjustment of r for h. Efficiencies generally are lower with the short pipe; the curves cross.

Q is considerably greater, and q is slightly greater. This result agrees with the attendant circumstance that efficiencies are lower.

General Conclusion. When high efficiency is desired, operate according to curves 5 and 6. Maximum efficiency is usually secured by running at a fairly high rate of strokes. When maximum capacity is wanted, and efficiency is of secondary importance, run at the lowest possible rate of strokes.

ECONOMY OF THE TUNGSTEN FILAMENT LAMP FOR SMALL CONSUMERS.

It is surprising, and yet somewhat to be expected, that the average householder should be slow in adopting the tungsten lamp for general use in his home. There are a number of reasons for this, chief among which are the lack of knowledge of the effectiveness and economy of tungsten filament lamps, and their comparatively large first cost.

The present tungsten filament lamp is more fragile than the carbon lamp and will not stand rough treatment given it through ignorance or carelessness. Now and then there are complaints that tungsten filament lamps have stood up only a comparatively short time and nothing other than the first cost is considered when the complaint is made.

Below is given a brief table showing the short time it is necessary to burn the lamp in order that the saving in current consumption may equal the difference in cost price between a 25-watt "Mazda" and 60-watt carbon and between a 40-watt "Mazda" and a 100-watt carbon lamp. These are the sizes of lamps most generally used in residence lighting and the table will make it apparent that each additional hour of burning after the difference in price is made up means a big interest earned on the investment. In fact, the lamp will actually pay for itself several times over besides giving a quality and quantity of light that is most satisfactory. One 25-watt "Mazda" has about the same candlepower as one 60-watt carbon. One 40-watt "Mazda" is about equal to one 100-watt carbon. The 25-watt "Mazda" costs 65 cents, the 40-watt "Mazda" 70 cents, the 60-watt carbon 20 cents and the 100-watt carbon 30 cents.

There is given below the number of hours necessary to burn a "Mazda" lamp to save in current enough to equal the difference in price between it and an equivalent carbon at various current costs.

	Hrs.		Hrs.
6c per kw. hour.			
25 w. "Mazda" 60 w. Carbon	220	40 w. "Mazda" 100 w. Carbon	110
8c per kw. hour.			
25 w. "Mazda" 60 w. Carbon	160	40 w. "Mazda" 100 w. Carbon	85
10c per kw. hour.			
25 w. "Mazda" 60 w. Carbon	130	40 w. "Mazda" 100 w. Carbon	65
12c per kw. hour.			
25 w. "Mazda" 60 w. Carbon	110	40 w. "Mazda" 100 w. Carbon	55
15c per kw. hour.			
25 w. "Mazda" 60 w. Carbon	90	40 w. "Mazda" 100 w. Carbon	45

The above take in the usual ranges of prices of current and sizes of lamps in residence.

It might be well to add that pendant or wall switches should be used where tungsten filament lamps are installed and that they should not be taken out of the socket and dumped into a dishpan to be washed. Lamps should be cleaned with a moist cloth while burning. This precaution, if observed, will do away with considerable breakage and resulting dissatisfaction.

The advantages of tungsten filament lamps for residence lighting are obvious. Interior finish is almost uniformly dark in color in the more used portions of the modern home and plenty of light is absolutely necessary as side wall reflection is almost totally lacking. The "Mazda" lamp affords the most economical means of gaining this desired end.

ENGINEERS DINE IN POWER PLANT.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers was held in the Southern Pacific Company's new electric power plant at Fruitvale on the evening of May 19, 1911. The design and construction of the plant were described by A. H. Babcock and his assistants and the visitors were given every opportunity for complete inspection. These papers will be published in an early issue of this journal. A subsequent meeting at the Oakland shops will be devoted to the line construction and car equipment of the Alameda County electrification for which this plant furnishes the power.

This meeting was preceded by a banquet at which a hundred or more engineers enjoyed the hospitality of the Southern Pacific Company. The dinner was unique, in being served on the main floor between the two 5000-kw. steam turbo-generators and the rotary converters, a score of waiters from the Southern Pacific diners attending to the wants of the party.

Photo by H. C. Tibbitts Dinner Given by Southern Pacific Company in Fruitvale Power House.

The guests included those members of the local section who have been most regular in attendance, the heads of departments of the electrical engineer's office of the Southern Pacific Company and representatives of the companies which furnished all the plant equipment. The list follows:

B. C. Edgar, J. J. Ferrier, F. E. Manzer, W. C. Myers, R. Page, Wm. Redford, F. H. Searight, G. W. Welsh, R. M. Alvord, C. F. Adams, A. H. Babcock, F. G. Baum, E. F. Bivins, A. J. Bowle, Geo. H. Bragg, Henry Bosch, Ralph Bennett, F. F. Barbour, H. W. Clapp, S. K. Colby, C. L. Cory, H. W. Crozier, J. G. De Remer, P .M. Downing, K. G. Dunn, R. B. Daggett, E. I. Dyer, W. H. Evans, S. L. Foster, R. H. Fenkhausen, Herbert Gaytes, H. Y. Hall, W. W. Hanscom, John C. Hays, Dorsey Ash, A. H. Halloran, L. F. Halloran, W. A. Hillebrand, G. C. Holberton, A. M. Hunt, C. S. Hull, C. W. Hutton, G. S. Johnson, A. G. Jones, L. R. Jorgensen, J. P. Jollyman, Geo. I. Kinney, W. F. Lamme, H. A. Lardner, O. W. Lillard, S. J. Lisberger, R. W. Lohman, H. A. Laidlaw, Paul Lebenbaum, W. C. Miller, Fred F. Mumma, Geo. R. Murphy, F. S. Hurst, S. L. Napthaly, W. F. Nieman, C. F. Orra, H. C. Parker, H. R. Roeding, L. St. D. Roylance, H. A. Russell, A. G. Ramstad, G. A. Schneider, Wm. H. Shepard, E. O. Shreve, H. H. Sinclair, F. E. Smith, Sidney Sprouut, A. B. Saurman, H. E. Shedd, C. E. Sedgwick, R. W. Van Norden, F. E. Vickers, W. G. Vincent, F. T. Vanatta, M. Vestal, Chas. J. Wilson, J. E. Woodbridge, C. T. Hutchinson, A. R. Thompson, A. D. Schindler, G. L. King, F. B. Clapp, D. J. Patterson, C. S. Stanton, R. F. Chevalier, Thos. Mirk, W. W. Slater A. A. Serva, S. W. Estabrook, Chas. Baker, R. Adams, J. Johansen, H. F. Jackson, C. R. Gill, J. W. White, W. R. Scott, F. W. Hoover, W. H. Norton, H. Stillman, W. A. Cattell, G. W. Dickie, G. L. Henes, J. N. Le Conte, E. A. Rix, J. C. H. Stut, G. R. Babcock, J. B. Struble, M. E. McKay.

Examination for Second-Class Steam Engineer is announced by the United States Civil Service Commission on June 21, 1911, to fill vacancies as they may occur in the position of second-class (or assistant) steam engineer in the departmental service at Washington, D. C. The examination will consist of letter writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first class public buildings), training and experience in mechanical and electrical engineering, and fitness.

SECURITIES OF WATER POWER COMPANIES AS INVESTMENTS.[1]

BY H. M. BYLLESBY.

Until recently it has been nearly the unvarying rule of men busily engaged in industrial or commercial pursuits to avoid everything resembling or pertaining to the making of addresses such as you have honored me with in your invitation to speak here.

However, within a comparatively brief period it has become necessary for those of us who are actively engaged in such pursuits to make a beginning by availing ourselves of the opportunities of addressing bodies of intelligent men for the purpose of placing before them certain real facts correctly stated in order to do away with, as far as possible, the present attitude of many of the magazines and politicians and those who pander to discontent by their misstatements regarding the work and methods pursued by those industrious men who are, while endeavoring to make something more than a mere livelihood for themselves, building up the country by developing the otherwise undeveloped and raw natural materials for a useful purpose and at the same time affording a means of livelihood and profit to a large number of others and as we hope and believe, helping forward the progress of civilization and ameliorating in general the conditions of human life.

Therefore I will ask you to regard my remarks as being those of a man who is unaccustomed to public speaking, but who believes what he says, and if what I have to say to you will be accepted in that spirit and, further, shall be of the slightest benefit to you young men before me who are about entering on the serious work and problems of life, and if at the same time in any sense it serves to give you a different view of modern commercial enterprises from that set forth in irresponsible magazines and on the part of discontented demagogues who, as always, are appealing to the unrest in the community, I shall feel amply repaid.

Growing Demand for Electricity.

Month by month and year by year the uses of electricity are increasing. In the earlier days it was necessary to demonstrate to the prospective user of any electrical device that it would actually perform its function; that the cost of the device or the cost of the electricity to operate it would not be prohibitive, or that some other device operated by some other force would not shortly take its place. Today all this is altered and from one end of the country to the other the usefulness and facility of the electric motor is recognized, the usefulness and advantages of electric light are recognized, the uses of electricity for many chemical processes are well known, and the question with any given prospective user in any given case is merely one of the cost of the electricity as compared with whatever other force or prime mover or illuminant may at the moment be at the disposal of such a prospective customer.

And this wonderful development of the use of electricity for industries and for comfort and for the luxuries of life is such today that any new use for electricity, even in our domestic establishments, the use of electricity for operating cleaning devices, flatirons, subsidiary cooking devices, is recognized, and again with the householder it is only a question of his ability to pay the cost of the device in the first instance, and the continuing cost of the electricity to operate.

Now there is hardly any business or enterprise which has ever been introduced which has such a unique demand for its product as do the manufacturers of that thing we call electricity.

Another feature leading to the stability of the bonds and stock of hydroelectric companies as investments is, speaking broadly and generally, there is a comparatively limited number of available water powers, either developed or undeveloped, and while in certain sections of the country there is a great overplus of water power, yet generally throughout the country there is far less water power than is equivalent to the total requirements for electricity for power, light and the subsidiary uses in the sections in which these water powers are located, and with rare exceptions, in fact the exceptions being so few in number as to be negligible, even in the sections which have been endowed by nature with an overplus of water power, those that have been developed, while temporarily oversupplying the market, have rapidly found uses for all of their product.

Finally and as a general rule, the class of men who heretofore have been connected with the development of hydroelectric projects have been men of character, of integrity, and generally their projects have not been seriously overcapitalized, almost without exception the enterprises have been honestly administered and there has been a certain enterprise and enthusiasm on the part of the men engaged in the development of these enterprises which has been of a high order and which has led to great enthusiasm and conscientious devotion to the interests committed to their charge.

So far there has been comparatively little of what is called "stock jobbing" connected with these enterprises; there has been comparatively little of the purposely embarrassing of these corporations for purposes of ultimate selfish greed and broadly it may be stated that there is no class of investment which has been more honestly administered, more industriously operated, or where the management has a greater degree of integrity than in the class of investments covered in the subject upon which you have asked me to speak.

Beyond this it is inevitable that in the near future the present 5 per cent (and in some cases 6 per cent) mortgage securities of hydroelectric properties will be refunded into 4 per cent mortgage securities and that the preferred stocks of these companies will sell on a 5 per cent basis, and the natural consequence of this will be to the present holder of the bonds and stocks of the hydroelectric companies, that he will find his securities called in under such terms and conditions as are provided in the instruments covering the issuance of those securities, for the purpose of being refunded into lower interest bearing stocks or bonds.

Now I shall touch later on upon certain disappointing cases which have arisen in the hydroelectric business and I shall be able to give you the specific reasons for those disappointments and I shall be able to point

[1]Extract from address at University of Pennsylvania, April 7, 1911.

out how, notwithstanding the disappointments in practically every case, the enterprises eventually came out so that the original investors did not lose any of their principal and even in many of the disappointing cases not only regained their principal, but a more or less handsome speculative profit in addition.

Management.

The duties of the managers of an hydroelectric property are continuous and unremitting; there is the public to be dealt with, which is always a question requiring tact and thoughtfulness, and the public can only be dealt with successfully where the manager of a corporation is imbued with and firmly believes in the underlying principles of Anglo-Saxon justice and fair play. A management which deals in smart tricks, which cuts sharp corners, which in any sense fools the public, which says "the public be damned," you can depend upon it, will sooner or later bring the property under its charge into greater or less disrepute and financial loss.

A man to make a success in this or any other department of modern business must stand squarely upon the platform of dealing honestly with the public, with his associates, and with the interests committed to his care. This is tact, and the smartest thing that any man can do is to be absolutely and continuously honest, and such embarrassments as some of the public service corporations have had you can in almost every case trace back to trickery, to an attempt to fool the public or the shareholder. Fortunately that situation is passing away forever.

In addition to this the management of an hydroelectric proposition must be alert and active, must be continually looking for further profitable sales of its product, must be continually on the alert to fortify its position as regards possible competition, the loss of business or the invasion of its rights, the management must have financial ability so that from the means at their disposal they will seasonably and in advance of the actual requirements provide funds for the continuing extensions and developments and enlargements which is the almost universal experience of hydroelectric developments. The management, for instance, must not overstay the market and eventually be forced to raise its funds in a bad money market under humiliating conditions or perhaps at ruinous interest or brokerage rates.

The management, while providing for the foregoing, must at the same time do all those common sense things which result in giving a corporation, the same as an individual, a good credit as distinguished from a bad credit. No individual can tell at what moment he may be called upon to use his own credit or the corporation be called upon to use its own credit to tide over fortuitous or temporarily disastrous conditions, and the concern which is in high credit will always be able to do this, where the company which has not paid attention to this question of credit may be very seriously embarrassed.

Further than this the management must be on the alert for new and useful methods for the consumption of electricity which can be continually, from time to time, brought before the consumers of such company; only in this way can the company go forward and fulfill the maximum earning capacity and satisfaction to the public which it serves.

Capitalization.

Another point in dealing with prospective investments in hydroelectric propositions is the design of the capitalization of such corporation.

Among the disappointments incurred in this business in the past from causes which I shall explain in detail subsequently one of the most frequent has been the inflexible nature of its devices for raising capital. Any and every hydroelectric enterprise in addition to being provided with ample cash working capital, so that it may discount its running accounts and always be in funds for prompt payment of its mortgaged and capital interest and dividend requirements, should further be so equipped by the arrangement of its capitalization that at any time by the sale of bonds or additional capital stocks it can provide funds for further development of its business.

Conclusions.

Generally, in summing up the foregoing, I am of the opinion that as a class, hydroelectric securities are exceeded by no other class of securities both in their stability and in the return which they properly are enabled to make upon their investment; the field of their operation is continually expanding due to the continuing growth of the use of electricity for almost every conceivable purpose, and in selecting a given investment naturally one would consider the present financial condition of the company, its management, its means for raising further funds, the physical condition of its property, as well as its earning capacity in view of the necessity or lack of necessity of steam reserve or the fluctuations of the stream which operates it.

Heretofore I have given you as briefly as the subject would allow, a general resume of the main points which, as I understand, are covered in the question on which I have been asked to address you. I wish, however, now to warn you of the things to be avoided and in this connection I would not for one moment disguise from you the fact that a certain proportion of these enterprises heretofore undertaken in the United States and Canada have proven temporarily disappointing and for a time many of them have appeared as disastrous failures, due, however, to reasons which are well understood and to causes which no one will have any excuse for neglecting in the future. The primal causes of disappointments, of temporary disasters, and in one or two cases failures (and there are not more than one or two to my certain knowledge) that have occurred, in the entire range of the subject, can be reduced to:

First: Underestimating the cost of the project.

Second: To mistakes made in the measurement of the flow of the stream to be developed.

Third: Inflexibility of the financial design.

Fourth: Absence of surplus.

Underestimating.

As to the first, I consider it one of the crying evils of the entire engineering profession, including the architects of today, which is an almost invariable and unfailing underestimating of the cost of any given project, and in hydroelectrics it has been more excessive and more heartbreaking than probably in any

other industry because there have been more uncertainties connected with the estimating of the cost of such projects.

The so-called "McCall's Ferry" project, with which all of you are more or less familiar, and you certainly are if you are connected with any large banking interests, went into temporary disaster requiring drastic reorganization, due to the fact that not more than 50 to 60 per cent of the cost of building this enterprise was provided for. And this disaster was further aggravated by no provision in the capitalization of the company to allow for the raising of additional funds when the original moneys provided had been exhausted.

As an example of the proneness of technical men to underestimate the cost of construction and to which they are as prone as the sparks to fly upward, and from which many technical men never shake themselves loose, I will mention the instance of a body of experienced and able men in the hydroelectric business, their experience extending over a period of well nigh fifteen years, where in developing a large and very necessary reservoir they made some soundings (but not enough), they dug some test pits (but not enough) and located what they believed to be a rock ledge upon which they have begun to build a dam to empound the water in the reservoir, and now, after having closed the door for the raising of further funds, they find themselves in an extremely embarrassing position, because contrary to all geological data at their command, contrary to the showing of their test pits, this ledge of rock, instead of drifting uniformly across the gorge where the dam is being built, has now developed a "fault" at the center of unknown depth, and which can only be bridged over or made safe by the expenditure of about 25 per cent of the cost of the project, and if it were not for the fact that the men back of this enterprise had large individual personal means and ample credit, the raising of this additional money with their closed issues of bonds and stock would probably force this particular enterprise to a drastic reorganization.

Therefore, I urge upon all of you who are expecting to be connected in any way with the enterprises of which we are speaking, to make your estimates with the most painstaking care and conscientious toil, to leave undone no amount of work or experiment which will serve to make certain the grounds upon which you are making your estimates and beyond all this and after having estimated liberally for all requirements so far as you can see them, to provide additionally a substantial sum of money and at the same time to so set up your financial arrangement that if contrary to your expectations your original estimates are overrun, and the extra amount of money provided is exhausted, and you still have capital requirements in order to finish your enterprise, you may have the means to do so without forcing the property to a miserable reorganization.

Legalities.

And in addition to the necessity of estimating and providing for as carefully as you can the many requirements for the physical part of the development, do not forget to see that the legal end of every feature of your proposition is attended to beyond peradventure. Many hydroelectric enterprises have been put to very great expense and great hazards, due to faults in the legalities of their real estate, their flowage rights, their rights of way, or the privileges of occupying public highways, and in many cases due to faults in these so-called "legalities" at the critical moment they have been held up and forced to pay a monstrous figure for a small bit of overflowed land, for an unprotected portion of their right of way, or due to some flaw in real estate titles, and it has frequently occurred that these so-called "hold ups" have happened at a time when the enterprise could not possibly wait to fight the question through the courts as the attendant loss of credit with the underwriters and the public, and the attendant loss of income, possibly resulting in the washing away of partly finished construction, made it imperatively and absolutely necessary to pay the "blood money" price required and all of which would have been avoided if the legal details had been properly and carefully attended to at the beginning.

Load Factor.

I wish to touch upon the question of what is technically termed "load factor." It is easy to deceive one's self by a high rate received for the sale of electricity, and to make an investor either in securities of a going hydroelectric company or one who is contemplating joining a preliminary underwriting, to be woefully deceived by the statement that in a given case the company will receive $75 or $80 or $100 or $150 per h.p. Now suppose that in a given community or given industry, due to its high rate of cost of fuel, you did receive a rate of $150 per h.p. but that your load factor was, for instance, 20 per cent. Your gross income from a given plant would be no better than if you had a load factor of 100 per cent and sold your electricity at $30 per h.p., and I have known of extremely disappointing cases resulting from promoters and managers being carried away by the large unit price for electricity where owing to conditions of its use a total gross revenue of but small amount was received, and this runs naturally into the very broad question of the sale of secondary electric power, by which is meant the sale of electricity at irregular intervals and in irregular amounts.

You may have a given hydroelectric development, for instance, which for six months in the year can deliver to the consumers continuously 10,000 h.p. and for the remaining six months can deliver only 5000 h.p. or the fluctuations and extremes may be more wide than I have stated. Now, owing to the comparative newness of this business, and the enormous number of things which people connected with it have had to give earnest attention to, the question of the sale of secondary power has as yet not reached the proportions to which it is entitled and broadly has been disappointing. I confidently believe, however, that the time will come when the hydroelectric development in any normal situation as to market will be able to sell to some one every kilowatt of electricity which it is able to turn out from the water flowing through its works. One very practical way to accomplish this, particularly in your eastern section where the bulk of your industrial enterprises operate on the so-called eight or ten-hour day, is to arrange, as can be done, that certain of

the users of this electricity work at night instead of day time, if only for part of the year.

Income From Secondary Power.

If, in a given eastern location you had a 10,000 h.p. hydroelectric proposition, and you had consumption of power for the operation of trolley roads, some small electric lighting and largely for furnishing power to industrial enterprises, happened to be 10,000 h.p., but that from 6 o'clock in the evening until 7 o'clock the following morning you had only a small load for part of that time from the trolley system, a heavy peak load for the balance of the period, you would immeasurably increase the earnings of your property without probably any material increase in the operating expenses if you could induce certain of your consumers or certain manufacturers who are not taking power from you in the day time, when you did not have it, to operate at night during which period they would purchase power from you.

Also with further study and development it will be found feasible to furnish to given manufacturing enterprises excess electricity, they using their steam plant to carry all or a small part of their load as the case may be, purchasing from the hydroelectric company necessarily at a low rate owing to the lack of guarantee of service, such electricity as the hydroelectric company can furnish from time to time.

Cost.

As to the cost of hydroelectric developments, it is no more possible to give any really guiding figures than it would be to state the size of a piece of cheese. The cost of these developments varies through the widest possible limits, and the market justifies or fails to justify to very wide limits, the varying degrees of cost of these propositions. And in this regard there is one very great danger, one very serious pitfall I wish to warn you against, which I am glad to say is becoming appreciated by engineers, managers and the public at a rapid rate, and that is that the cost of your transmission lines, your substations, your extensive subsidiary apparatus, your pole line right of way, and your individual distribution will in many cases exceed the cost of the hydroelectric plant, and very rarely is materially if any less than the cost of the plant, because if the same painstaking care and thorough workmanship is lacking in the transmission lines or extensive subsidiary apparatus of a plant which has been given properly to the building of the dam, power house and general machinery you will have continuous, difficult and expensive repairs, interrupted service, and a generally unsatisfactory condition of affairs.

In our experience, which has been fairly broad, we have known the cost of completed water powers of large dimensions, including their transmission lines and substations and a small amount of local distributing line for large power consumers, to run as low as $125 per installed h.p. We have also known them at the same time being commercial successes, to reach $700 or $800 per h.p. A steam plant, not including any distribution system, but simply the power house, boilers, engines, generators and internal subsidiary apparatus broadly vary from in very large plants $50 or $60 per h.p. to $125 to $150 per h.p., but all of these general figures I think are repugnant to any correct general view of the situation. Each case must be carefully examined from the conditions bearing directly upon it, and deductions made in accordance with a careful study with the experience of the investor himself or guided by the experience of some other man of experience upon whom he can depend.

With the daily increasing demand for electricity for almost every conceivable purpose from electric light, through power, chemical processes, power for pumping, for its use in the household, in the office and in almost every detail of human life, and with the further development of the sale of secondary electricity, and even with a fair reduction in some cases in the price now charged, the prosperity of all properly built and properly financed hydroelectric propositions should continually incease.

Conservation.

In the West we have our own quarrels with the Conservation Policy of the Federal Government and of the various State governments, and as this while at the present time more or less local, is becoming anything but local in its bearing on the collateral interests involved throughout the United States because a suspension in the further development of water power projects has its direct reflex effect not only upon the communities depending upon such developments but also upon the entire fabric of the manufacturing interests of the country, the copper producers and manufacturers, the manufacturers of electrical and water wheel machinery, the manufacturers of structural iron and steel, the manufacturers of cement and building materials, and the railroad companies suffering or prospering in accordance with the absence of transporting of materials for water power development or transporting such materials, and therefore on this subject I wish to say a few words.

Up to three or four years ago, and in many cases at the present time, the men of enterprise and who were able to provide capital to develop hydroelectric enterprises in the western states have been welcomed by the entire community. It has been recognized that where a given stream for countless ages has been flowing through an untenanted wilderness, serving as far as the power of the stream is concerned, no useful purpose, there has been a desire to provide the proposed company with a free gift of the power proposed to be developed, free right of way, not to hamper them as to rates, recognizing the difficulty of providing capital to build such enterprises, recognizing the brain and genius required to think out and plan the enterprises and recognizing beyond all this, the very great appreciation in value resulting to all the tributary population, property and interests in the communities to be served by such hydroelectric development.

I have been working in this field for many years, being one of the earliest workers and it has been only recently that it has been at all a simple matter to provide capital to develop some of the propositions which have proven most highly profitable. There was skepticism on the part of the investor, and skepticism on the part of the banking interests. There was the antecedent history of so many enterprises which had been embarrassed if not reduced to tem-

porary failure by costing more than had been expected, and heartbreaking anxieties on the part of the investor, the promoter and the builder. In addition, the long history which by a fatality seems to have attended nearly every hydroelectric development which is, no matter how carefully in the past the maximum and minimum flow of the stream has been ascertained from such records as were available, that nevertheless during the progress of the construction work a given stream has violated every previous record, either as to high or low water, entailing temporary disappointment or monetary loss.

All these conditions have been recognized generally in the past, but a few years since the cry went up that while in the east a very material part of its great commercial development had resulted from the free development of the natural resources, water powers included, without any exasperating or drastic restrictions. That, notwithstanding this, the wilderness of our western country, which is sparsely settled, where the power is generally grievously needed by the commercial interests and the inhabitants, that in these cases the mortmain of Federal and State Governments must be placed upon such enterprises; that they must be hampered and impaired in every conceivable way until finally by the straining of every possible interpretation of the laws and by the creation of new laws, the Federal Government, and many State governments will allow the development of non-developed water courses under conditions which are almost prohibitive. The conditions broadly and generally being that they will give a permit to the hydroelectric company to put up its works, costing several hundred thousand or many million dollars; they will allow them to occupy the stream for a limited period of twenty or forty years; they sometimes reserve the right to regulate the rates which the coporation may make, and reserve to themselves the right, in some cases at any time during the period of the permit, but in all cases under the present program, at the termination of the permit, to do anything they see fit with the hydroelectric development. The government can refuse to renew the permit; it can force the company to remove its works or renew the permit at ruinous rates, all to be determined by the wisdom of the Federal or State officers at the time that this contingency arises.

Along with these permits a royalty charge is made for the use of the water, which no company seriously objects to. What is objected to is the "making of bricks without straw"; offering these permits under conditions which make it impossible to raise capital to build them.

As to the general conservation policy of Federal and State Governments, there are of course, as in every question, points of merit which every fair minded man thoroughly agrees to. In the timber policy, there is no reason whatever why if a tract of timber is cut over, new trees should not be planted, and the man who cuts the timber should be forced to plant new trees or follow any other wise provision.

In yielding water power privileges to companies on public domain, no company will object to the payment of a fair and proper royalty on the water used, but to follow a policy as outlined by men who as a rule have accomplished nothing in the world excepting as to politics, who could not either devise such a project, as they are now legislating against, or if they could devise such a project, would know of no nook or cranny in the wide world where they could command sufficient credit to raise a dollar towards it, and to have men of this sort actuated by more or less fanatical motives, appealing as most of them do, to the ignorance and prejudices of the public, enforcing policies which put the dead hand of the law upon one of the most notable achievements of the Anglo-Saxon race in the United States, which is its enterprise, brings up for immediate and serious thought on the part of all fair-minded people, such a modification in the spirit of these policies as will conserve that most valuable asset which the people of these United States have heretofore possessed, but which I fear they are beginning to lose very rapidly, and which is the industry, enterprise and the daring courage of the energetic men who have developed the resources of this country, and which these unfair policies and unfair laws will inevitably drive to fields of industry in Canada or South America or elsewhere.

ELECTRICITY IN BRITISH SOUTH AFRICA.

Some interesting facts relative to the progress of electricity on the Witwatersrand are shown in the annual report of the Government mining engineer.

There was a large increase in the use of electrically driven machinery in connection with the mines, the horsepower of motors having risen during the year ended June 30, 1910, from 76,299 to 108,354. Owing to the fact that the electrification of the power supply of a majority of the mines is now rapidly going ahead, this total will be largely increased during the present year. This scheme contemplates not only the employment of motor-driven turbo-compressors for supplying compressed air, but motors will also be used for winding and pumping and in a majority ot cases for the mill drive. The induction motor has been chosen by many of the mines for winding purposes, this being generally the case when it was necessary to convert an existing steam hoist, but it is understood the Ward Leonard system has been adopted in most instances where a completely new winding plant was required.

Examination for First-Class Steam Engineer is announced by the United States Civil Service Commission on June 21, 1911, to fill vacancies as they may occur in the position of first-class steam engineer in the departmental service at Washington, D. C. The usual entrance salary of this position is $1200 per annum. The examination will consist of letter writing, practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first-class public buildings), training and experience in mechanical and electrical engineering, and fitness. While graduation from a technical school is not necessary, it will be given due consideration in the rating of the subject of training, experience and fitness.

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electricity in Mining

Mining, like growing potatoes, is a commercial possibility only when the economic laws governing cost of production and market value can be satisfactorily adjusted. The fact that a mine may contain the necessary mineral deposits is but one of the features which control this adjustment.

When the mines on the Comstock Lode of Nevada were at the height of their production, all power machinery was driven by steam, which in turn was generated from fuel of high cost, for coal was brought great distances, while wood soon depleted the forests. During this period the ore was of sufficient richness and the mines easily enough worked to make the production commercially of great value, notwithstanding high unit costs. As the mines became deeper, and the best ore was worked out, there came a time when the costs of operation overbalanced the output and business practically came to a standstill. There still remained large quantities of gold and silver to be mined, but the economic conditions surrounding the mining were such as to make ground, once of untold value, practically worthless.

The advent of cheap electricity and modern electrical machinery instantly changed the economic conditions; pumps which to that time could be worked only at the greatest cost or not at all, could now be cheaply and easily operated, restoring drifts which had been considered lost to the world. A new lease of life was given by making one kind of Nature's resources assist in working another.

For modern mining it is necessary to have power and water, and where these necessities can be had easily and cheaply, the business of mining stands the best possible chance of continued success. It is for this reason that many low grade mines, situated in mountainous places, operate year in and year out as steadily as a shoe factory and make a consistent profit at every cleanup, while desert mines, rich in deposits, but lacking the advantage of cheap power and water, struggle fitfully and often fail.

Many of the older mines on the "Mother Lode" of California which have been good payers, have had these cardinal advantages by being so situated that water under high pressure could be brought directly to the mines to supply the power needed. To operate a mine by water power was the dream of delight of the old-time miner, and when the change to electricity came to those mines which were fortunate in having water power, it was hard to convince the more conservative that their condition was being bettered.

Mines hitherto without cheap power can now be reached by the electric transmission lines which are ever increasing in length. Motor drive has been so perfected that it is applicable to every phase of mining and milling as well as smelting. The winning of metals, though one of the last great industries to adopt this ideal power, is destined to be one of the most satisfactory power loads in this Western country. Many of the problems are analogous to those already solved in other lines of work, so that future progress should be most rapid in this field.

PERSONALS.

Leon M. Hall visited Reno and Virginia City during the past week.

Gano Dunn has been elected president of the American Institute of Electrical Engineers.

Roy C. Fike, of the Home Telephone & Telegraph Company, of Los Angeles, is at San Francisco.

J. Flanagan, an electrical contractor of Stockton, was a San Francisco visitor during the past week.

Geo. Cole, of the John R. Cole Company, has returned to Los Angeles after spending three weeks at Los Angeles.

Marston Campbell, superintendent of public works of the Hawaiian Islands, has arrived at San Francisco for a month's stay.

A. M. Hunt left last week for New York. He will spend about a month in the East in connection with engineering projects.

E. G. Robinson Jr., manager of the Jim Creek Water, Light and Power Company, at Arlington, Wash., is at San Francisco.

E. R. Davis, assistant manager of the Pacific Light & Power Company of Los Angeles, recently spent a few days at San Francisco.

F. B. Gleason, manager of the Western Electric Company's branch, returned to San Francisco last Friday after a trip to Salt Lake City.

H. C. Goldrick, Pacific Coast manager of the Kellogg Switchboard & Supply Company of Chicago, is making a tour of the Pacific Northwest.

Edson F. Adams and W. H. Leffingwell made a trip last week to the site of the Mono Power Company's hydroelectric plant on the Owens River.

Delos A. Chappell, of the Hydroelectric Company, is at Podie, California, on business connected with the reconstruction of the plant.

Edgar S. Hurley, formerly in the San Francisco department of electricity has been appointed chief electrician of the Geary Street Municipal Electric Railway.

M. F. Orrick, formerly in charge of the telephone sales department of the Western Electric Company at San Francisco, has gone to Salt Lake City to take charge of the company's branch at that point.

John Coffee Hays, general manager of the Mt. Whitney Power Company, and connected with the management of the La Grange Water & Power Company, and other enterprises of John Hays Hammond, is at San Francisco.

P. T. Hanscom has been appointed general superintendent of the Great Western Power Company with headquarters at San Francisco. He was formerly connected with the management of the Central Colorado Power Company.

Horatio A. Foster was in San Francisco this week en route from Los Angeles to the East. As a former classmate and old friend, he was entertained by Samuel H. Taylor of the Electric Railway and Manufacturers' Supply Company.

W. K. Fruedenberger, formerly electrical engineer for the Steptoe Valley Smelting & Mining Co., McGill, Nev., has been appointed engineering expert for the Public Service Commission of Nevada. He has been succeeded by R. E. Middagh.

Mortimer Fleishhacker who is connected with the management of the City Electric Company, left for New York last Thursday to complete the details of the transfer of the Great Western Power Company. The $150,000 option on the City Electric Company expires June 1, and it is expected that in future the Fleishhacker interests will have much to do with shaping the policy of the Great Western system.

TRADE NOTES.

G. A. Wilbur, representative of the Duncan Electric Manufacturing Co., the Triump Electric Co., the Helios Manufacturing Co., et al., has moved from 61 to 78 Second street, San Francisco.

L. E. Sperry, formerly manager of the California Electrical Works (now the Western Electric Co.'s San Francisco house), has established offices and warehouse at 629 Howard street, San Francisco, as the representative of the New York Insulated Wire Company.

J. C. Farrar & Co., Los Angeles, Pacific Coast agents for the Electrical Engineers Equipment Company, have received a large order for the material to be used in wiring the new 100,000 kw. turbo-generator station being built by the Southern California Edison Co.

The General Electric Company has lately shipped to the Southern Power Company a 12,000 ampere triple pole 650 volt a. c. circuit breaker to be used in controlling the current from the 600 volt side of a 11,000/600 volt, 60/40 cycle, 6600 kw. frequency changer set. This is the largest capacity a. c. circuit breaker that has ever been manufactured.

A fire in the factory building of Partrick, Carter & Wilkins Co., Philadelphia, on the night of May the 16th caused considerable damage and a temporary shut down. The loss is being adjusted and arrangements made for an early resumption of work. They ask their friends in the trade to be patient with them for any delays in filling orders as they expect to be in full operation shortly.

The American Electric Fuse Company and the Hygrade Incandescent Lamp Company have arranged with The Northwest Electrical Equipment Company of Portland, Oregon, for representation in that territory. The company will also act as manufacturers' agents for several other specialties, such as overhead material for electric railways, steel transmission towers, electric hammers and tools, underground conduit, wires and cables. The new concern is at 530 Lumber Exchange, and W. H. Barnes, formerly of the J. C. English Company is president and general manager.

The General Electric Company reports the closing of a large contract with the Pacific Electric Railway Company of Los Angeles for electrical machinery and equipment, including the following: Four 2-bearing, motor-generator sets, each consisting of one M. P. C. 8, 1000-kw., 500 r.p.m., 600 v., d.c. generator, direct connected to one A. T. I. 12, 1120 kw., 2200 v., 50 cycle, 3-phase synchronous motor. Three 2-bearing motor-generator sets, each consisting of one M. P. C. 6, 600 kw., 750 r.p.m., 600 v., d.c. generator, direct connected to and mounted on the same base with one I. 8, 900 h.p., 750 r.p.m., 2200 v., 50 cycle, 3-phase induction motor. Fifty quadruple G. E. 210, 60 h.p., 500 v., railway equipments, with G. E. Type M controllers. Nine 450-kw., water-cooled transformers and nine 300-kw., water-cooled transformers, all designed for 15,000 volts for primary and 2250 volts secondary.

NEW CATALOGUES.

Bulletin No. 32R from the Helios Mfg. Co. represented by G. A. Wilbur, 78 Second Street, San Francisco, gives valuable data regarding the "Helios" incandescent series street lighting system.

The Pacific Gas & Electric Company have issued a beautiful 275-page book regarding its properties and territory served, giving the finances, history and statistics of each subsidiary company. It is handsomely illustrated with halftones and contains several maps.

The Westinghouse New Model Roney Mechanical Stoker is illustrated and described in Circular W. M. 504 from The Westinghouse Machine Company. Brief reference is also made to the Westinghouse chain grate stoker and the Westinghouse coal crusher.

ELECTRICAL CONTRACTORS' NOTES.

The National Electric Company of San Francisco has been awarded the wiring contract for the John Swett School.

C. W. Schneider, of the Electrical Supply Company of Sacramento, has been spending a few days at San Francisco.

W. S. Hanbridge, president of the State Electrical Contractors' Association, spent last Thursday at Sacramento and Stockton.

The Butte Electric and Engineering Company of San Francisco has been awarded the contract for wiring, etc., for the Polytechnic High School and adjoining shops.

The Central Electric Company of San Francisco has several large wiring contracts in hand, the larger ones including: The temporary City Hall, $26,500; the Rialto Building, $8000, and twenty buildings for the new artillery barracks at the Presidio, amounting to $10,000.

The Decker Electric Company of San Francisco has almost completed a $75,000 construction contract at the Presidio, including a sub-station and the wiring for the illumination of the buildings, parade grounds and yards.

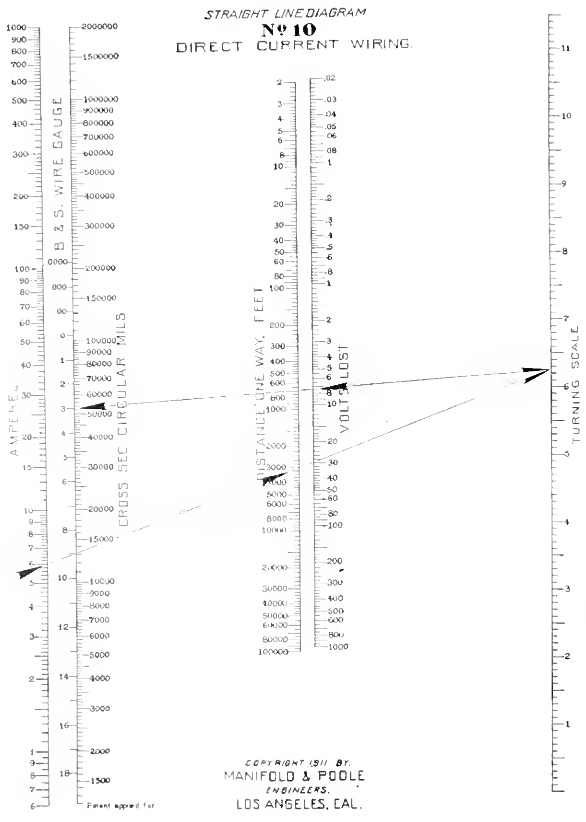
Possibly the electrical specifications, which were prepared by a New York architect, can be modified so as to reduce the cost considerably. It is understood that about $5000 worth of reflectors were specified for use in the City Council's meeting room. It was not stated whether the object of so much reflection of light was to prevent grafting in the Council or otherwise.

John G. Sutton & Co. of San Francisco were the lowest bidders on the electrical work for the new City Hall at Oakland, their figure being $40,000, as against the highest San Francisco bid of $55,050 by the Pacific Fire Extinguisher Company, and the Eastern bid of $57,000 put in by L. K. Comstock of New York. The other bids were as follows: Butte Electric and Engineering Company, $41,990; Central Electric Company, $48,000; Fell Electric Company, $52,000; Standard Electric Company, $45,750; Newberry, Benheim & Co., $44,800. The very low minimum figure of local bidders and the wide range of other figures, all being below the single Eastern bid, seem to indicate a great anxiety to secure business regardless of profit. It is probable, however, that all of these bids will be rejected and the entire construction work on the City Hall readvertised, for the total of the construction bids filed was $300,000 in excess of the $1,000,000 bond issue.

ELECTRICAL CONTRACTORS MEETING.

The California State Association of Electrical Contractors will meet at Catalina Island during the second week of July. A party of 100 or more will leave San Francisco on July 8 on the Harvard or Yale, a special rate of $10.50 having been made for the round trip. The contractors of Southern California have made big preparations for this event, which is of interest to all in the electrical trades. Full details will be published later or may be obtained directly from W. W. Hanbridge, 68 Post street, San Francisco.

A COMPUTING WIRING DIAGRAM.



The accompanying straight line diagram gives a simple and rapid method of estimating direct current copper wiring. It is used by permission of Manifold & Poole from a forthcoming enlarged edition of their book on "Straight Line Engineering Diagrams."

The diagram is seen to consist of six scales. The first is laid off proportionately to the number of amperes to be carried by the wire, from 0.6 to 100 amperes. The second gives the wire sizes in the B. & S. gauge, while the third gives the corresponding cross section in circular mils. The fourth scale gives the distance one way in feet, the fifth shows the volts lost, while the sixth is merely a turning scale for carrying results forward.

To use the diagram it is merely necessary to connect a known point on one scale to a known point on another, and read the desired result at the intersection of a straight-edge with the intervening scale.

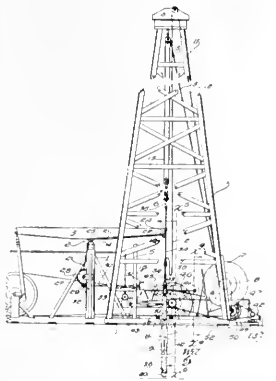
The problem solved by the lines on the diagrams is to find how many volts are lost in transmitting 6 amperes 3000 ft. through No. 3 wire.

A straight-edge passing through 6 on the first scale and 3000 on the fourth scale intersects 6.25 on the sixth scale, this point being used as a pivot to connect to No. 3 on the second scale, thus intersecting 7.5 on the fifth scale, which shows that 7½ volts are lost. If No. 8 wire were used 24 volts would be lost, while with No. 0 wire 3.75 volts would be lost.

Or if the problem were to find how many amperes could be transmitted by No. 3 with a loss of 7½ volts between points 3000 ft. apart the operation would merely be reversed. Similarly, if it were required to find what size of wire is necessary to transmit 6 amperes between points 3000 ft. apart with a volt loss (or drop) of 7½. Other problems are solved in the same manner.

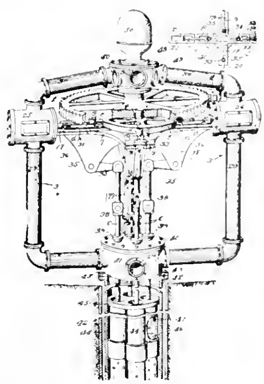
PATENTS

992,527. Combination Standard and Hydraulic Drilling Rig. Wilson B. Wigle, Lompoc, California. In a drilling rig, the combination of a bull wheel, a calf wheel, a pump, a casing line connected with the calf wheel, a casing, a bushing for the casing, a hose-connection between the bushing and the pump, a stuffing-box in the bushing, a line casing extending through the stuffing-box, a drilling line extending through the line casing and connected with the bull wheel, packing for said drilling line



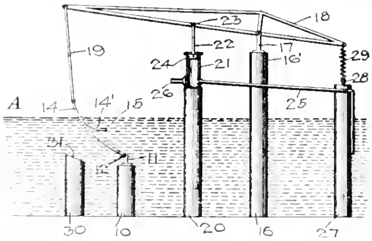
in the line casing, elevators for the casing, a clamp for the drilling line, a walking beam, means for operating the walking beam, pulley means on the walking beam, connections led over the pulley means and connected with the clamp, take-up means for said connections, means under the control of the operator for operating such take-up means, means connecting the elevator with the casing line, a line shaft and clutch connections carried by said line shaft for respectively operating the calf wheel, the pump and the bull wheel.

992,493. Multiple Pump. Stanley L. Fulford, Los Angeles, Cal., assignor of one-fourth to Benjamin Allen Brown, Los Angeles, Cal. The combination of a frame having two crossed guide-ways, two slides arranged to slide in the guide-ways and each provided with studs spaced apart on opposite sides



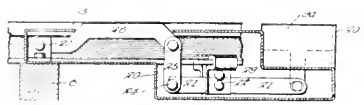
of the intersection of the axes of the slides; a master-wheel journaled on the frame, its axis being at right angles to the slides and alined with said intersection of the slides, a crank-pin on the master-wheel at one side of the axis thereof, a traveling-wheel journaled on the crank-pin and arranged between the studs to engage the studs to slide the slides in their ways, wrist-pins on the slides at opposite sides of said intersection, and bell-cranks pivotally mounted on the frame and operably engaging the wrist-pins.

992,390. Surf-Pump. George W. T. Snare, Ocean Park, Cal. An actuating means for a surf pump comprising a plurality of supports, journals mounted on certain of said supports, a shaft journaled on one set of said supports, a concaved impact element on said shaft and movable therewith,



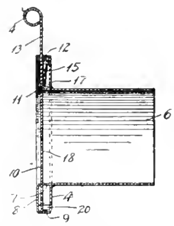
levers mounted in the other of said supports, connections between said levers and said pump, connections between one end of said lever and the impact element, whereby said lever is moved to operate said pump, and means connected to the opposite end of said lever for returning the device to initial position.

992,735. Actuating Mechanism for Station-Indicators or the Like. Orlando E. Kellum and Thatcher P. Wilson, Los Angeles, Cal., assignors to National Street and Station Indicator Company, Los Angeles, Cal. In combination with a rail over which a wheel is adapted to pass, a wheel engaging mem-



ber arranged alongside the rail and pivotally mounted at one end in connection therewith, a clamp secured to the lower edge of the rail, a lever pivoted on the clamp beneath the rail, connection between the free end of the wheel engaging member and one end of the lever, and a movable contact member connected to the other end of the lever.

992,293. Flume-Gate. Elmer O. Thomason, Covina Cal., assignor to Kellar-Thomason Manufacturing Company, Covina, Cal. A gate comprising a tube having a projecting end, a face place having an opening, coinciding with the opening of said tube, said opening having a lip at the edge thereof



adapted to come against said seat when the gate is open, a slide adapted to be forced between said lip and the tube and clamped therebetween, and means for guiding the lower edge of said slide into alinement with the plane of the end of said tube.

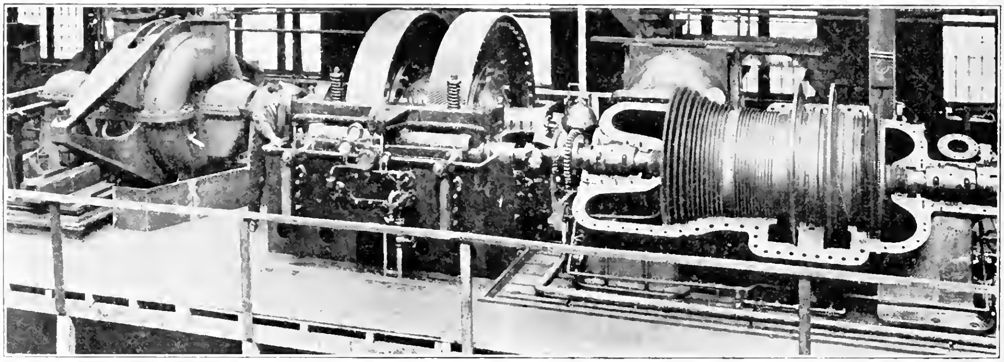
INDUSTRIAL

WESTINGHOUSE MARINE TURBINE AND REDUCTION GEAR INSTALLATION.

Two marine turbines and reduction gears are being installed and shipped by the Westinghouse Machine Company upon U. S. collier "Neptune," a ship of about 19,000 tons. These tests are regarded by naval men as of the highest importance because of the use of comparatively small turbines and reduction gears interposed between their shafts and the propeller shafts, it being claimed that the weight of this class of machinery will be less than half of the weight of other turbines having the propellers coupled direct to the turbine shafts or of reciprocating engines, and that, by reason of the higher speed, the turbines used with reduction gears will require especially for cruising speeds, from 20 to 30 per cent less steam than is now needed by any of the turbine driven ships or ships driven by reciprocating engines.

The upper half of the turbine is arranged so that it can be quickly thrown back upon its hinges in order that all of the blading of the turbine may be quickly inspected. To illustrate the value of this feature to Admirals Betbeder and Garcia of the Argentine Navy and Admiral Cone, Chief Engineer of the U. S. Navy, who have just visited Pittsburgh for a critical inspection of the apparatus, the top cover of the turbine was loosened, removed from its place, the rotor containing the blades given a complete revolution by hand, and the cover restored to its place and the engine again started, all in less than one hour—to be exact, in fifty minutes; this in contrast with several days required to open up and similarly inspect the turbines for one of the screws of a modern battleship.

The reduction gearing has a floating frame for maintaining uniform tooth pressure, but the means for floating the pinion frame is of a novel character and not only provides for an elastic motion and a separation of metallic connection between the casing of the pinion and the main casing (which reduces vibration), but at the same time provides an hydraulic dynamometer whereby the exact propeller shaft horsepower being delivered by a turbine, can be read from a gauge. This dynamometer arrangement is mathematically and practically correct and will give advantages in the running of steamships of the very highest importance.



View of Westinghouse Marine and Reduction Gear with Upper Casting of Turbine and Reduction Gear Removed. The Brake is Shown at Extreme Left.

The design of the turbines adopted has an ahead portion and a reverse portion, and a cruising element, all within one casing. The control mechanism is of an exceedingly simple character and is so arranged that each engine may be run in either direction at any speed up to the maximum, either by mechanism operated in the engine-room or by a duplicate operated from the bridge of the ship, the latter feature being of high importance in the maneuvering of a ship. In fact, the man on the bridge can reverse either or both turbines from full speed ahead to full speed astern in less than fifteen seconds, or in much less time than it now takes to communicate signals from the bridge to the engine-room with other types of control. The speed and direction of both turbines being under instant control, permits of the turning of the ship in the shortest possible distance, and in the event of the steering apparatus being disabled, the ship can be steered and kept to its course by the manipulation of the speed of the turbines. The overspeeding of the turbine engines from any cause whatever, and especially in a heavy sea, is automatically prevented by the governor control. All steam and exhaust connections are made to the lower half of the turbine and the general construction is such that the steam may be turned directly into the apparatus when cold and full speed attained in less than a minute; whereas, the form and dimensions of the turbines which have heretofore been used for naval service have been such that the turbines required pre-heating before starting, such pre-heating taking from three to ten hours, according to the size of the machinery.

The United States government has already applied a number of turbines for the propulsion of war vessels, and after prolonged tests, the General Board reached a conclusion, which it recently promulgated publicly that no further battleships would be fitted with turbine machinery of the kind that they have so far experimented with. The controlling reason for this decision is the large amount of steam and coal required to propel these ships at cruising speeds with turbines as compared with reciprocating engines.

A demonstration by a trial on the "Neptune" of the practicability of reduction gearing for large horse powers will it is believed change the entire situation with reference to the application of power to naval vessels. The saving of over one-half of the weight in engines and a decrease in the capacity of boilers required because of a less consumption of steam is of the highest importance as it permits of the use of thicker armor and heavier guns.

The turbine and gear equipment being installed upon the "Neptune" represents over five years of study and experi-

mentation under the direction of Mr. Westinghouse in the works of the Westinghouse Machine Company in the development of turbine machinery for the propulsion of ships. The departures from previous practice, which are radical, have been made in the interest of lessening the cost of constuction, facilitating the operation of the machinery and its inspection, and in the reduction of the weight and space occupied, as well as in providing a control mechanism whereby the officer in charge of the ship may, without the intervention of any other person, has as complete a control of the engines as he now has of the steering apparatus.

SMALL DIRECT CURRENT METERS.

A great demand has arisen in recent years for small indicating meters for battery charging installations, small isolated plants, Cooper Hewitt rectifier outfit and similar small installations, which shall have a high degree of accuracy and at the same time be marketable at a price that will not be prohibitive for the service.

To meet this growing demand the Westinghouse Electric & Manufacturing Company, of Pittsburg, a few years ago placed on the market the Type L ammeters and voltmeters, which have recently been improved to such an extent that they are the equal of many higher priced instruments now on the market.

Fig I.

The meters are 5 inches in diameter, which makes them very convenient for use on small panels. At the same time, the scale is 4 inches and uniformly divided, so that it is fully as legible as some large meters.

The movement of the meters is similar to that of the larger, high grade meters made by the Westinghouse Company. The principle used is the D'Arsonval, or permanent-magnet moving-coil principle, but its application in this case is unique; the magnetic circuit has a single air gap in which the moving coil, moves pivoted at one edge. This arrangement results in several advantages. The single air gap can have larger clearance for the same magnetic strength, making it easy to keep it free from dust or iron filings; the complete moving element can be removed and replaced without disturbing in any way the magnetic circuit or its strength; the entire magnetic circuit can be magnetized, aged and tested as a unit, making variations unlikely.

As shown in Fig. 2, the magnetic circuit is self shielding, and iron cases are not required to protect the instruments from stray magnetic fields.

The moving coil is wound on a light metal frame, the damping effect of which makes the reading dead beat. The frame is carried on especially hardened steel pivots bearing in polished and carefully fitted sapphire jewels. As the coil is pivoted at one edge it acts as a counterbalance for the pointer. This reduces the total weight on the pivots, making friction a minimum and thus tending toward accuracy and long life.

The meter scales are hand calibrated, which eliminates any slight irregularities of the magnetic circuit that may exist. In case of injury to the calibration through overloads, simple adjustments are provided for correction.

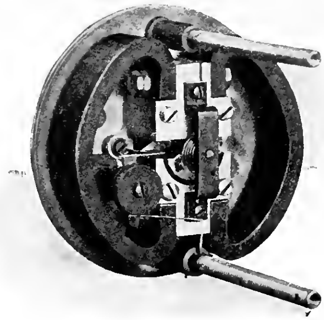


Fig. 2.

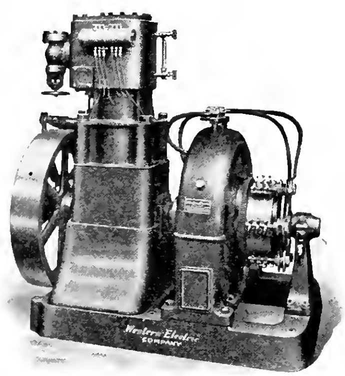
The cases of the meters are of moulded hard rubber, giving the meters a finished appearance. The meters are attached to the panels by means of brass studs which serve also as terminals. Ammeters up to 300 amperes and voltmeters up to 300 volts are listed in the company's catalogue.

WESTERN ELECTRIC STEAM DRIVEN DIRECT CONNECTED GENERATING UNITS.

To meet the demand for a direct connected generating set, especially adapted for power and lighting service in isolated plants or marine installations, and as exciters in large central stations, a new steam driven set has just been placed on the market, known as the "Western Electric" Hawthorn type ML direct connected generating unit.

These sets are furnished with 110 and 125 volt direct current generators, ranging in capacity from 2½ kw. to 75 kw., direct connected to single cylinder or tandem compound, vertical engines which operate condensing or non-condensing at steam pressures of from 35 pounds to 160 pounds.

The engine and generator are assembled on a common cast iron base, which extends the full width of the generator and provides ample base surface for foundation without increase in floor space required.



Western Electric ML Type Steam-Driven Direct-Connected Generating Unit.

The engines are of the vertical marine type so constructed as to insure perfect alignment, balance and adjustment for possible wear. Perfect alignment of the parts is attained by casting the cylinder, valve chest and crosshead guides in one piece, and machining them at a single operation. The piston

rod and cross head and likewise the crank shaft and half coupling are forged from one piece of best machine steel, and by careful and accurate machining of all parts, perfect alignment is further insured. A balanced piston type valve, accurately ground to fit in the steam chest, produces close regulation and freedom from excessive friction. The piston used is equipped with hard cast iron spring rings which effectively prevent leakage of steam. A simple and efficient fly-wheel governor maintains a constant speed by automatically varying the steam admission and compression. This is effected by the motion of the eccentric pin, mounted on a carefully balanced fly-weight which is very sensitive to slight variations in speed. The governor requires very little attention as there are practically no parts subject to wear. The engines are furnished with either the gravity or the forced system of lubrication, and adjustable sight feed tubes allow the regulation of the flow of oil to the various parts.

The generator frame of the smaller sets is cast in one piece of high grade iron. The frame of the large sets is of cast steel and is split horizontally. Soft cast steel poles are rigidly bolted to the frame. The armature is built of high grade sheet steel laminations, pressed on an iron spider and provided with numerous ventilating ducts. Hard drawn copper conductors are form wound and thoroughly insulated with moisture-proof materials before being placed in the slots. The highest grade copper and mica, together with expert workmanship, produce a most reliable and durable commutator. The field coils are very liberally designed, provided with many ventilating ducts and thoroughly insulated. The brush rigging is supported by the bearing, except in the 50 kw. set, on which it is supported by the magnet frame. Individual spring adjustment on the brush holders permits the removal of the brushes for inspection and their return without altering the brush tension.

THE WESTINGHOUSE FORM P2 PORCELAIN STRAIN INSULATOR.

There are many conditions for which properly designed porcelain strain insulators are admirably suited. They are largely used in guy wires by street railway and by electric power companies. Groups in series are used at dead ends to take the strain of and to insulate the line wires.

Westinghouse Form P2 porcelain strain insulators are made of a grade of porcelain much superior to that ordinarily used for such appliances. The glaze is a dark brown so the insulators do not readily attract attention in the air. Sharp corners that would be apt to chip have been avoided and the shape of the grooves is such that the wires lie naturally in them. The dimensions of the three sizes are shown in the accompanying table. The break down voltages when the insulators are dry is about 20,000 volts for each of three sizes. The approximate ultimate tensile strengths of the insulators, when wired up in guy wires, are respectively 14,000 lbs., 16,000 lbs. and 23,000 lbs.

Even if a Westinghouse Form P2 insulator fails either because of excessive stress or through accident, the wires that it carries cannot drop because they are interlinked. Two Form P2 insulators are often installed in series; then if one breaks, the other provides insulation. It is very improbable that two will break at the same time.

Style No.	Form	A	B	C	D	E
138271	C1	2 3/8"	3 1/8"	5/8"R	3/8"	15/16"R
138272	C2	2 3/4"	3 1/2"	3/4"R	1/2"	1 1/16"R
138273	C3	3 1/4"	5 1/4"	7/8"R	3/4"	1 1/4"R

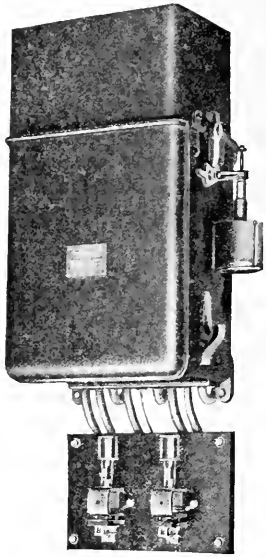
TRADE NOTE.

The C. A. Smith Lumber Company has purchased a Westinghouse 200-kw. belted a.c. generator of the new type. It will furnish current for motors in connection with the extension of the factory at Bay Point for the purpose of making portable houses. A number of Westinghouse motors have also been purchased.

NEW OIL BREAK SWITCH FOR MAN-HOLE SERVICE.

It is oftentimes desirable to install an oil break switch in a man-hole or other location where obviously the ordinary type of oil break switch is not adapted to this service, as there is danger of flooding. To meet this need, the General Electric Company has developed a water-tight oil break switch substantial in construction and suited to operation on circuits up to 7500 volts, in which the normal current rating is 200 amperes, or less.

These switches are made in non-automatic form, single, double and triple pole, single throw. The frame cover and oil vessels are of cast iron and all joints are made water-tight by means of gaskets. The frame is provided with a large vent hole to which a pipe may be connected and extended above the water line to prevent undue strain on the gaskets, due to gases generated when the switches are opened under load. The operating handle is outside the frame and can be operated by hand or by a hook. The shaft to which the handle is attached passes through the frame in a watertight stuffing box. The leads are carried to and from the switch through the bottom of the frame, water-tight bushings being provided for this purpose on the frame.



Single Pole Manhole Switch with Two Outlets.

The double and triple pole switches are so arranged that each lead may pass through a separate outlet, or one outlet may be used in each end of the frame for double or triple conductor cable.

The stationary contacts consist of flared fingers of drop forged copper supported from the contact blocks of the current carrying copper studs by heavy flat steel springs. The studs are supported and insulated from the frame by porcelain insulators. The movable contacts are wedge shaped copper blades actuated by specially treated wooden rods connected to the cross head, which in turn is operated by the handle and actuating mechanism. The construction of the stationary and movable contacts is such that the arc is ruptured between the flared portion of the stationary and the upper extremity of the movable contacts protecting the actual contact surfaces. This form of construction insures clean contact surfaces, uniform contact under pressure, and does not retard the opening of the switch. The General Electric Company's Bulletin 4831 gives detailed information regarding this switch.

NEWS NOTES

FINANCIAL.

LOS ANGELES, CAL.—Certificate of change of principal place of business has been filed by the San Joaquin Light & Power Corporation, from the city of Fresno to the city of Los Angeles.

PENDLETON, ORE.—The city is now authorized to issue bonds to the extent of $200,000 for the purpose of constructing a pipe line from Thorn Hollow Springs at the foot of the Blue mountains to this city, a distance of 18 miles. Two reservoirs are also included in the expense.

TUCUMCARI, N. M.—The citizens have voted that $75,000 bonds be issued, $10,000 of which will be used in improving the present water plant; three miles of new mains will also be laid into the suburban district of the city. A standpipe will be erected and about 65 fire plugs will be installed.

ONTARIO, CAL.—The city has purchased the pipe line of the South Side Water Company for $6000. This will be used in the new municipal water system. The Leeke-Walline system at the north end of the city has also been purchased for $16,000, and this will also become part of the municipal system.

SACRAMENTO, CAL.—The gross earnings of the Sacramento Electric, Gas & Railway Company, a subsidiary company to the Pacific Gas & Electric Company, according to a report made before the State Board of Equalization, were $500,000 for 1910. The company also reported that its earnings—for the Pacific Gas & Electric Company—increased $500,000 during the year, over the earnings of 1909.

ILLUMINATION.

NEWPORT, CAL.—The City Council has passed an ordinance calling a special election for the purpose of submitting the proposition of issuing and selling bonds in the amount of $55,000 for the construction of a municipal light works.

ROSEBURG, ORE.—Bert Sutherland of the Water & Light Company has received a telegram from J. L. Kendall, of Pittsburg, containing instructions to go ahead and install a temporary plant in place of the one recently burned.

CASTLE ROCK, WASH.—The Council has passed an ordinance granting to the Silver Lake Railway & Lumber Company authority to construct and maintain lines for the transmission of electric energy within the limits of the town of Castle Rock.

SANTA ANA, CAL.—The Southern California Edison Electric Company has filed a contract with the Tustin Lighting District for the installation and operation of 110 electric lights on Tustin streets, to be installed by July 15th, and to cost $1.15 per light per month.

PASADENA, CAL.—General Manager Koiner of the electric department estimates the cost of the needed addition of an electrical unit and steam engine at the municipal lighting plant at from $30,000 to $35,000. He states it must be paid for by loaning the department money or by bonding the city for the cost.

SUSANVILLE, CAL.—James Branham has made application to the Board of Trustees for a franchise to construct and maintain poles and wires for the transmission of electricity for heat power and light, along the streets and alleys of Susanville. Sealed bids will be received by the board up to June 1, 1911.

PALO ALTO, CAL.—The City Council has adopted an ordinance reducing the maximum rates for light and power in Palo Alto. The lighting rate was reduced from 10c to 7½c per kilowatt hour, and the power rate from 5c to 4c. The charge for power for domestic uses was fixed at 3c. The reduction in rates will affect both the municipal lighting plant and the United Gas & Electric Company.

ROSEBURG, ORE.—The W. F. Boardman Company of San Francisco, who were recently awarded a gas franchise in Roseburg, have filed with the city recorder a certified check for $5000 as a guarantee of fulfilling their agreement to install in this city a gas system costing $50,000. Having already secured a site for the gas plant it is expected that they will begin active operations early.

GRANTS PASS, ORE.—A. W. Butler, who has secured a gas franchise here, has purchased from C. E. Phillips and Geo. Barrows a site for the plant. The gas holder to be constructed will have a capacity of 50,000 cubic feet. Generators will have a capacity of 200,000 cubic feet daily. Crude oil will be the material from which gas will be generated. The cost of the plant is estimated at $60,000.

REDDING, CAL.—The Siskiyou Electric Power & Light Company has been granted a franchise by the Board of Supervisors to erect and maintain poles and wires over the roads and highways of Shasta county and upon the streets of unincorporated towns for a period of 50 years. The company's lines now cover Klamath Falls and Ashland, Ore., on the north, and Sisson and Dunsmuir on the south. The company will extend its lines at once to Castella and eventually will work further south, according to President Jesse W. Churchill. The Siskiyou Light & Power Company is now developing 20,000 h.p. and has water enough to develop 40,000 h.p. more.

TRANSMISSION.

VICTORIA, WASH.—This place is calling for bids on furnishing 300 electric light standards for street lighting purposes.

VISALIA, CAL.—The Mount Whitney Power Company will erect a two-story building in West Main street, plans for which have been drawn and accepted.

TACOMA, CAL.—The department of light and water has awarded a contract to the McCormick Lumber Company, McCormick, Wash., for 2500 cross-arms, at $955.

PROSSER, WASH.—The commissioners have granted the Pacific Light & Power Company, a 50-year franchise for the transmission of electric power lines in Benton county.

WALLA WALLA, WASH.—C. S. Walters, manager of the Pacific Power & Light Co., announces that work will soon be started on the construction of a high power transmission between this place and Dayton.

LEAVENWORTH, WASH.—The Snow Creek Water Company, the Icicle Company, and the Tumwater Light & Power Company have made application to the city for a franchise for the exclusive furnishing of water and light.

REDDING, CAL.—A crew of men has commenced work on a 6,000 foot tunnel through the watershed between Cow Creek and Dry Burney Creek. This is the beginning of the Northern California Power Company's great water conservation project, whereby a storage reservoir of 1640 acres will be made by damming Dry Burney Creek. The water is to be caught from the winter floods and stored for the purpose

of generating electrical power will have an average depth of twenty feet. The water will be sufficient to generate 6,000 h.p. at the company's power house.

SEATTLE, WASH.—Plans and specifications for the installation of a steel pipe line from the proposed Lake Union hydroelectric plant at Volunteer park to Lake Union were approved by the Board of Public Works. The specification calls for 2100 ft. of 40-in. pipe and 950 ft. of 36-in. pipe.

QUINCY, CAL.—A notice of appropriation of 50,000 miners' inches of the water of the north fork of the Feather River has been filed in the office of the county recorder by Leroy G. Brown. The purpose of the location is to utilize the water for the generation of electricity at three different points on the stream.

EUGENE, ORE.—The city water board has asked the Council to submit to the people the question of issuing $57,000 in bonds to strengthen and extend the municipal electric plant. The installation of a complete electric distributing system for commercial lights and power and the rehabilitation of the hydroelectric plant at Waterville is contemplated.

GRANGEVILLE, IDAHO.—A number of those who are heavily interested in the Grangeville Light & Power Company are here from Spokane looking over the Ten Mile country with a view to erecting a power plant in that section and furnishing electric power to the mines now operating in that camp and vicinity.

SAN FRANCISCO, CAL.—The Spring Valley Water Company and the Pacific Gas & Electric Company have closed a $100,000 contract for the electric power to be used in building the latter company's Calaveras dam in Alameda county. Already the power company has men in the field preparing for the construction of a power line from Sunol to the Calaveras dam site, a distance of ten miles. The first work will be the sluicing down of the mountain side on each side of the canyon where the 230-foot dam is to be built. When finished it will flood 1200 acres and will be capable of supplying 30,000,000 gallons of water daily, or nearly double the capacity of the present system.

TRANSPORTATION.

LOS ANGELES, CAL.—Contracts for construction work on Glendale-Burbank branch line of the Pacific Electric Railroad have been awarded to Robert Sherer & Co.

SALINAS, CAL.—The Supervisors of San Benito county have declared forfeited the franchise granted to J. C. Kemp Van Ee, in July, 1905, to construct an electric road upon certain highways, because nothing was ever done toward building the road.

RIVERSIDE, CAL.—Representatives of the Pacific Electric Company will shortly appear before the Board of Supervisors and ask for a franchise and right of way between the city limits of Riverside and the Orange county line; 17 miles of track will be required.

SAN JOSE, CAL.—The San Jose Railroad has started its work of standardizing and double tracking its Fourteenth street line with the ultimate view of extending the line to Alum Rock by way of Berryessa. Frank E. Chapin, manager of the San Jose Railroad, denies that the Southern Pacific is behind the Almaden mining men and ranchers promoting a plan for an electric road between this city and New Almaden.

BERKELEY, CAL.—Appication for two new street railway franchises were filed with the City Council last week by the Oakland Traction Company. The first application is for an extension of the line up Spruce street to Los Angeles avenue and thence to the Northbrae circle, the second calls for a change in the running of the Grove street cars on Adeline street in South Berkeley. If the proposed change is allowed the Grove street line will cross the Southern Pacific and Key Route railway tracks at a grade crossing at Adeline and Felton streets, running up the west side of Adeline street, to remove congestion of traffic. The franchises will be brought up at the next next meeting of the Council.

FRESNO, CAL.—The actual work of laying ties and rails on the F. S. Granger Railroad will be started on or about the 1st day of next July, according to Mr. Granger. The latest of the grading gangs now at work in the field is to establish a camp about one-half mile north of Lone Star, on what is known as Jensen avenue. With this camp as its headquarters a force of men is now engaged in grading toward Sanger. "If everything goes right," said Mr. Granger, "our railroad will be started in actual operation on December 15th next. The one thing that we are anxious about is that the General Electric Company, which has the contract for the establishment of our power plant, will be through with its work by that time. If we have the electricity, everything else will be ready by the time mentioned.

TELEPHONE.

HANFORD, WASH.—Wheat growers east of this city have organized an association and will construct a telephone line from their district to Mesa, Wash.

MARIPOSA, CAL.—The petition of A. C. Smith and others for the privilege of erecting a telephone line on the Mariposa and Le Grand road, has been granted.

CORNING, CAL.—The Board of Town Trustees at its last meeting granted the franchise asked for by the Tehama Telephone Company, through Joseph P. Tait.

HERMISTON, ORE.—The Farmers' Educational & Co-Operative Union of America are planning a network of telephone lines embracing all towns and surrounding territory of the western half of Umatilla county.

COTTONWOOD, IDAHO.—The Mutual Telephone Company has decided to construct rural telephone lines into Camas and Nez Perce prairies. An appropriation has been made to build a 25-mile line into Joseph plains district.

NEW WESTMINSTER, B. C.—Geo. H. Hales, secretary of the British Columbia Telephone Company, announces that the automatic or central energy telephone systems will be installed here next year. An additional story will be built to the telephone station, and its equipment improved.

WATERWORKS.

LOS ANGELES, CAL.—Samuel L. Walker has applied to the Board of Supervisors for a water franchise covering Baldwin Park and nearby territory.

ALBANY, ORE.—Manager Green of the Oregon Power Company, announces that a $30,000 water system will be put in, work on which will begin at once. It will have the gravity system and be mechanically operated, flushing itself.

EUREKA, CAL.—W. G. Corbaley, superintendent of the Eureka Water Company, who has just returned from San Francisco, states that contracts have been let for the construction of the water tower in southern Eureka. It is estimated that the water tower and tank will cost, all told $30,000.

TACOMA, WASH.—The Council has passed an ordinance providing for the laying of a six-inch iron water main in Local Improvement District No. 575; also providing for the laying of a 12-inch wooden water main on Park avenue from South 72d to South 76th street; a six-inch wooden water main on South 73d, South 74th and South 75th from Park avenue to J street, and on J street from South 72d to South 75th street, according to plans prepared in the office of the Commissioner of Light and Water.

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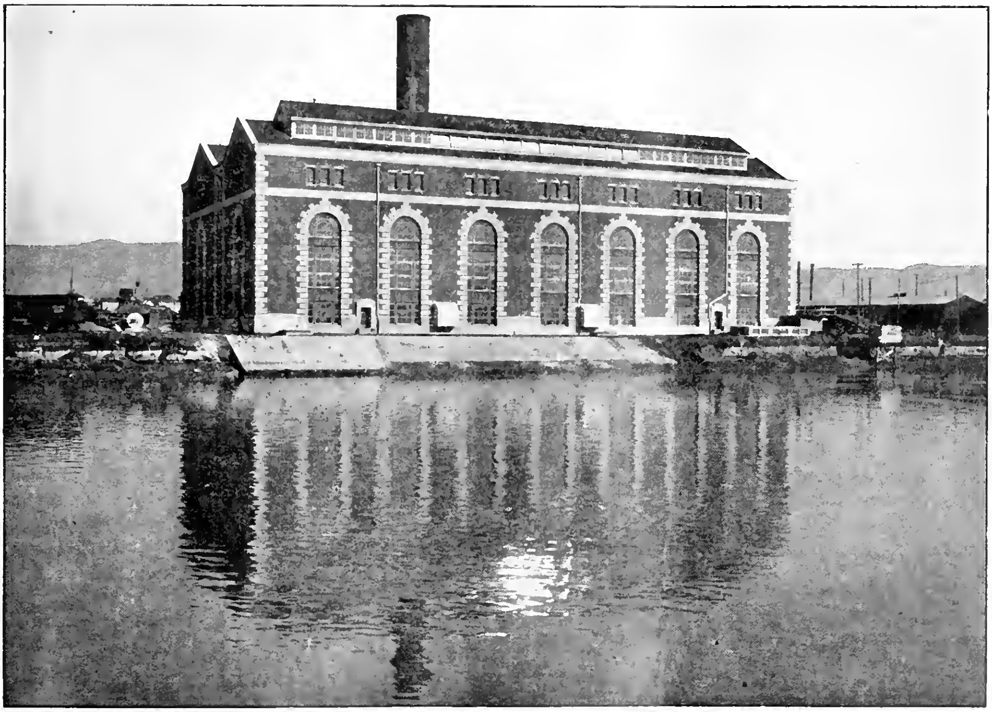
THE FRUITVALE POWER PLANT[1]

S. J. Lisberger: The meeting will please come to order. We have been accorded a most unusual courtesy tonight, that of being invited to hold our meeting in this power house. We are still to be accorded a more unusual courtesy, namely, to listen to a description of the engineering details of a modern plant illustrated by the plant itself. The man who is responsible for this great work, and who knows all about it, will tell us how it was done. I take pleasure in introducing to you Mr. Babcock, who will preside tonight.

A. H. Babcock: The chairman has referred to the man who is responsible, and who knows all about it, and who will tell you what happened. Now, there is only one fact in his statement. There is, of course, somebody responsible, in the ultimate, for a work of this kind, but he can not know it all. Any man who has a piece of work of this kind to handle is dependent absolutely on the men associated with him, who carry the detail, and who bear the burden of such an enterprise.



Southern Pacific Company's Electric Power Plant at Fruitvale, Cal.

It is not my purpose to try to tell you anything about this plant other than the general features and the general intention, and I will leave the description of the details entirely to those who designed them, the associate and assistant engineers of my office. In the first place, it may be well to state the general purposes of the plant. The electrification of all the lines around San Francisco Bay, generally speaking, is the ultimate purpose—that is to say, all of the lines on both sides of the Bay. The first step is being made now; the other steps will follow as fast as the service conditions will

[1]Papers presented at meeting of the San Francisco Section of the American Institute of Electrical Engineers at the Fruitvale Power House of the Southern Pacific Company, May 19, 1911.

warrant the expenditure of the necessary money.

The location of the plant was determined by the usual two or three conditions that control such selections, namely, the presence of condensing water at low temperature available in large quantities; a piece of ground not too expensive, and a soil that will not demand expensive foundations. (The ordinary fuel requirements do not apply here).

The general scheme of the power house installation is:

First: A 13,200 volt, 25 cycle, 3-phase generating system for distribution to substations in accordance with the traffic requirements; and also for the supply of a high tension transformer house to take care of the further extensions to the suburban system just mentioned.

Second: Entirely independent of the large generating apparatus in the station is installed a 125-250 volt direct current system for the supply of all the generating excitation circuits, the station lighting circuits, the crane and all the station auxiliaries. This direct current system is reinforced by a storage battery to insure a continuous supply of power for the station auxiliaries and lights in case of accident to the main generators.

Third: Within the main station is located one of the substations with its conversion and control apparatus suitable to supply power to the trolley lines within economic reach of this point.

The station at present designed is to hold four units of approximately the unit capacity of 5000 kw., according to the contract for the generating units. As a matter of fact these units are so liberally designed that under test conditions it was impossible to raise their temperatures beyond the contract guarantees until a continuous load of 7500 kw. had been applied to them. It follows then that with the two units installed there is practically 15,000 kw. capacity available in the present installation or with four such units the present building can provide easily 30,000 kw. output; and the west wall is constructed in such fashion that it really amounts to a temporary wall, beyond which there is available space for the installation of two more similar units, or a total of 45,000 kw. station capacity.

At the other end of the station, namely, where this meeting is now being held, three 1500 kw. rotary units are installed, and where your chairs are now placed it is intended to install three similar units whenever the suburban train requirements shall require the additional capacity. The rotaries are designed in as liberal fashion as are the generators. Although they are nominally 1500 kw. capacity per unit, a continuous load of 2250 kw. is required to bring them to their safe operating temperatures; and the commutation under extremely fluctuating conditions is all that can be desired.

The building was designed in this fashion, i. e., larger than present requirements demand, in accordance with instructions received from Executive Officials to provide for sufficient capacity to take care of all of the load, present and for some time in the future, that may be developed when the entire electrification of the Bay district shall have been completed. Also, in accordance with similar instructions the boiler room and its facilities have been designed for conversion to coal firing later, whenever the fuel conditions of this market shall make such a change desirable. There is ample space over and alongside of the boilers for coal handling and automatic stoking apparatus, and under the boilers a suitable space has been left to take care of the ash handling apparatus: in other words, while the plant is now being oil fired, if the market conditions make it desirable we can change to coal at a comparatively slight expense. The ground to the east of the power house has already been laid out for coal storage and conveying apparatus.

It is with considerable regret that I have to say tonight that Mr. Miller, who is responsible for the mechanical design of this plant and for the design of the steel structure that is enclosed within these walls felt obliged to go out of town and will not be present. I hoped that he would be here to give you in greater detail than I can a description of that part of the work for which he is responsible.

The design of this building, that I think you all will agree with me, is unique and proper in every respect, is entirely due to D. J. Patterson, formerly architect for the Southern Pacific Company. He is responsible for the architectural features, and I wish to call on Mr. Patterson for a few words as to that part of the outfit.

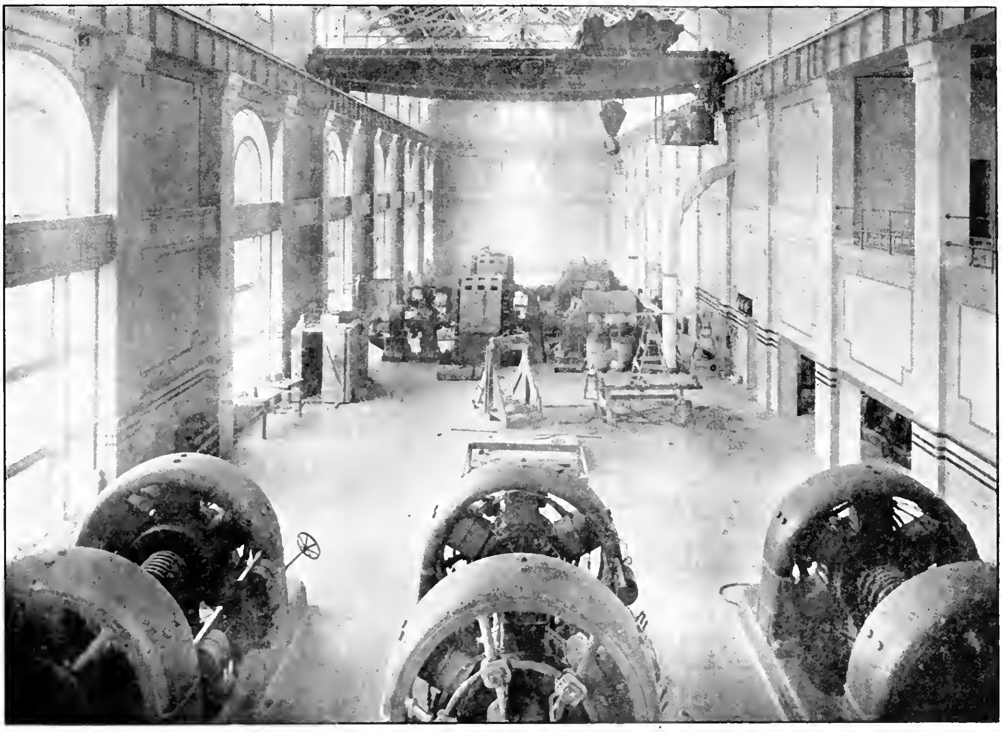
Architectural Features.

D. J. Patterson: Until a few moments ago I did not know that I was to be called upon to say anything. In the spring of 1907, at the suggestion of Mr. Babcock, I made a trip through the East to the various cities that had constructed large power plants, and thereby gained such information as would be necessary in building this structure. In September of that year I met Mr. Babcock in Schenectady, New York, to get instructions from him, and armed with letters of introduction I visited the cities of New York, Boston, Philadelphia, Pittsburg and Chicago.

The idea was to gain as much knowledge as possible that might be used in the construction of this building, although it is greatly modified in form from anything that I saw. No doubt many of you who have visited the East noticed that these buildings are elaborate; in fact the expense in many instances has not been considered at all, but we out in the West consider the best way to spend our money and get the most out of it, and from the things that I saw and the information I gained I obtained my ideas that were used in the construction of this building.

The exterior of this building is constructed of ordinary building material, such as is used in the construction of common warehouses. Everything throughout was built in that sense until we got to the interior of the building.

The idea was to make this building look the best possible on the inside and not go to any great expense. One thing you will observe here, and Mr. Babcock instilled it very strongly into my mind, is the floor. The floors has been a great fault in all buildings of this character because of their getting stained and marked by oil, and we looked carefully into the material to be used. The tiling of this floor was put through a severe test. Every class of material was



Interior of Power Plant Showing Rotary Converters in Foreground and Turbo-Generators in Rear

thoroughly tested until we found what we thought would meet the requirements, and to a certain extent I think we have succeeded in accomplishing the purpose. The interior of the building, as you will see, is ornamented in a simple way compared to other structures of this character. The tiling of the wainscoting can easily be kept clean, and above that the walls are covered with ordinary plaster which was painted with three coats of ordinary paint and decorated in the manner that you have seen. The object has been to not over-ornament the building, not over-decorate it, but to make the place a harmonious whole in keeping with the character of the structure. That is the colors of the floors and walls were all so designed that they would be one harmonious whole and be entirely in keeping with the character of the building that it was designed for.

A. H. Babcock: I feel that Mr. Patterson has not said as much as might be said about the building. The steel frame that is enclosed within the walls was designed by J. C. Lathrop, who is now in an eastern engineering office. The steel was fabricated at the American Bridge Company's plant, then sent out here and was erected by the bridge force of the Southern Pacific Company. When the steel plans were sent to us by the bridge company they were checked in the office through a process that will be given to you later in detail. Any additions to the steel structure were noted, any parts that were not to be used were noted, and a complete memorandum of those changes, additions and subtractions was given to the bridge foreman, when the bridge crew went to work. He told me some months after the structure was completed that in every instance Mr. Miller's check of the drawings had come out exactly as was given in that memorandum; the things that were not to be used they did not have to use; and the things that had to be added were found necessary in every instance. I merely mention that as a tribute to the business skill of an engineer. Usually it is considered that an engineer has not much business sense; but I would like you all to understand that Mr. Miller has both engineering skill, which you now see, and has also business sense as evidenced in the other way.

In Mr. Miller's absence I shall ask Mr. Ferrier, office engineer and assistant to Mr. Miller, to give us as near as possible the description of the plant that Mr. Miller would have given if he were able to be here; also in addition to that, to state briefly the manner in which such engineering is carried through the office. He will begin with the orders of the general manager to prepare estimates upon which to ask for an appropriation; the procedure that is followed when the appropriation is made, and the routine of the office through which the contracts, specifications and drawings are carried before the work goes into construction.

Details of Office Engineering.

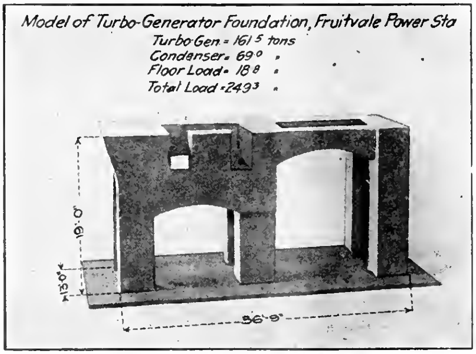
J. J. Ferrier: One of the features of electrification work seldom brought into discussion, primarily because of the importance of the construction features, is that of office engineering. In the beginning estimates

are prepared and submitted to the management for what is called an "A F E" (authority for expenditure.) Considerable care is necessary in preparing such estimates for obvious reasons. When the expenditure is authoried it becomes a "G. M. O.," (general manager's order), against which all charges are made.

Having determined the possible arrangements, we then issue a requisition on the General Store Keeper for the material, for the larger material, he in turn places an order on the General Purchasing Agent who in turn sends out invitations for bids. The bids when received are sent by him to the Electrical Engineer's office for his recommendation.

For the purpose of determining the best interests of the company a comparison chart is made of all the bids and the results are easily arrived at. If the manufacturers or agents send their proposals in, along the lines specified, our work is expedited. We also use a clause permitting bidders to make proposals on similar material. Recommendation is then made to the General Purchasing Agent embodying also our suggestion for the terms of payment, and in the large orders, certain contract clauses.

At this time request is made for outline drawings of the successful bidder that final designs may be made of the arrangement and buildings. Paper templets of the machinery are great time savers at this point of the work; cardboard models were also made of the turbo-



Cardboard Model of Turbo-Generator Foundation.

generator foundations, and the smoke flues, which all helped to get to a conclusion. Color schemes can be used to good advantage at this time in laying out the different piping schemes. Approximately 550 drawings and 50 sets of specifications were made and finished in our office of the power house and sub-station work.

About this time the contractor takes up his correspondence with the Electrical Engineer's office; drawings are received and checked by us to the contract requirements. The errors and changes that have developed on this work were many and considerable trouble in the field was saved by having the errors rectified on the drawings. All drawings received on this work both from contractor or our associate offices are checked by at least two men for design and errors, and their report when culled forms the body of the letter to the contractor. Each man uses a distinct color in checking the prints, etc.; the entire check is left upon the office sets, and only those remarks that are of importance go on the set which is returned to the contractor.

The contractor then submits revised plans and these go through the same routine and when finally approved, Van Dykes or negative prints, are sent to the company, and we then make our own prints for distribution.

It is surprising the number of times that some drawings had to go through the mail. An Eastern engineer can hardly appreciate that it takes from two weeks to a month to get replies from the East. In other words, before going 3,000 miles a subject wants to be clearly defined. Of course, we have telegraph communication and some contracts have been placed almost entirely by telegraph.

After approval of drawings we send specifications and drawings to an inspection firm if the contract is in the East, or to our own inspector if the contract is local. This has insured our getting what was specified and in the event of necessary changes we were advised in time to arrange accordingly. It also kept us in touch with the progress of the work and expected shipping dates. Tests were also made at the factories.

The shipment and delivery of material is then made to the Division Storekeeper of the company who in turn notifies us of its arrival, and obtains from us the directions of re-shipment. Considerable work is involved in tracing material to destination. Subsequent erection follows. Daily reports from the men in the field are sent to the Electrical Engineer's office, and customary tests and acceptance or rejection followed.

As to the payments, the policy of the Electrical Engineer's office is for standardization although consideration is given the contractors when framing terms of payment. He has his current expenses to meet, and much aggravation and hard feeling can be stirred up by neglect in making proper arrangements. The usual ten per cent generally is reserved for final payment until written acceptance is given, providing delays by the purchaser are taken care of. Some of these contracts had payments made on the amount of work done and others had a fixed amount at stipulated times.

The bills for the material are usually sent to the General Purchasing Agent who certifies to the price being correct; he in turn sends the bills to the Electrical Engineer who passes upon the technical details, the receipt of material and the desirability of making final payment. The Purchasing Agent then sends the bills to the Auditor who in turn makes the voucher or check out and passes voucher through the Electrical Engineer's office. From this source we obtain our records of the costs both unit and in the aggregate, for guidance in future work, to assist in facilitating further expenditure on the same work, and to give information as to how much money is left in the G. M. O..

A very carefully prepared detailed record is also kept of the engineering cost on each specific G. M. O. Unless this is done and the distribution of it properly controlled it is surprising how the money provided for in the estimate can get away apparently from the purpose for which it is intended.

A weekly report from the respective subordinate

heads in our office was required so that the entire work could be completely reviewed. It has been shown by experience that while reports of this nature bother us by constantly recurring on given dates, usually they bring to attention matters that otherwise might be overlooked.

Very little overtime work has been allowed to be done by our forces. This to my mind explains in some measure why no serious error has been recorded on this work.

All drawings have been made to standard sizes; this brings about economy in filing space occupied, and the preservation of the drawings has resulted. Numerical and alphabetical indexes are kept.

An interesting feature is the use of a fire proof vault. Arrangements have been made to store in this building complete copies of all drawings and specifications beyond the reach of fire. This will prevent disorganization of the office in case of fire or theft. The speaker recalls that on similar work in the east every man in the office had a duty to perform in case of fire during the day; and suggests that possibly it is a good practical thing to be instituted in every office.

Correspondence has been reduced to the fewest letters possible, and to one subject for one letter. Carbon copies are made for each of the subject files and filed according to date. All letters and requisitions are given a serial number by an automatic numbering machine; this makes an easy reference. In addition to the subject files an extra copy on yellow paper is made and filed numerically and these have proven extremely useful in many instances. We have an effective system of tracing delayed correspondence, both on others and ourselves. All inter-office memoranda is carefully preserved and from experience we have learned the value of so doing.

A system of photography was introduced early in this work and progress photographs have been taken almost weekly. The results have demonstrated the wisdom of this introduction, and an explanation can be thoroughly made to any one with the picture before them. In case of accidents it proves a truthful witness. When dealing with franchises it is useful to be able to show that work was started or completed as the case may be within the specified time.

A. H. Babcock: While Mr. Ferrier is looking up his memoranda, I want to say one word in tribute to the men who have carried on that part of the work. The checking system just described by Mr. Ferrier was put in effect by Mr. Miller, with the result that considering the building where you are, in all the work that has gone through my office, there has not been a single extra on any contract, and there has not been a mistake to be rectified. That in itself speaks for the system, and the men who handled it.

Steam Details.

J. J. Ferrier: Mr. Babcock has taken up the general features of the plant, and I will now try to point out to you some of the details of the plant.

The turbo-generators are of the Westinghouse double flow type, 5000 kw. rated capacity, guaranteed for twice their rated load for one minute, and for 7500 kw. for two hours. The steam consumption at rated load was guaranteed not to exceed 15.9 lb. per kw. hour with superheated steam, and 18.2 with saturated steam and 1.10 load is guaranteed when operating non-condensing. The contract requirements are as follows: For 2500 kw. load the steam consumption is 18.3 lb. per kw.-hour. The Westinghouse tests showed 18.1; at 3750 the contract requirements were 16.7; the test developed 16.6; at 5000 kw. the requirements were 15.9 and that developed was 15.8; at 6250 the requirements were 16.3 and that developed 15.3; and at 7500 the guaranteed requirements were 17.5 and they developed 15. There is very little difference in the results of the tests of the two machines.

As to the surface condensers, they are of the Henry R. Worthington type. The tubes are not tinned. The circulating water is taken from the canal. The temperature of this water was taken during a period of a year and the maximum temperature of the circulating water was 65 degrees F. and the minimum 46 degrees F. We have both condensers inter-connected. We can use either circulating pump on either of the condensers, so that in case either turbine is running, and we should be so unfortunate as to have one of the circulating units go out, the other one could be used on either or both condensers. The air pumps are arranged so that cross connection can be made. The boilers are of the Parker type steam generators. There are twelve installed, each of 645 h.p. normal rating, and the results of the tests are briefly as follows: The guarantee was the equivalent evaporation of 14 lb. of water from and at 212 degrees F. per 1 lb. of oil, and the performance, developed 15.96 and 16.01. We have two tests recorded and the horse power developed on these tests was 676.7 and 650. The apparent water evaporation under actual conditions per pound of oil as fired was 13.25 and 12.79, and the equivalent evaporation from and at 212 degrees F. per pound of oil as fired was 15.77 and 15.91 respectively.

The customary flue gas, temperatures, etc., were all taken. The average steam pressure measured by gauge was 178 and 179 lb. and the oil pressure at the burners was 78 and 92 lb. The escaping gases from the boiler were 384 degrees F. The temperature of the oil at the burners was 128 degrees F. in one test and 113 degrees F. in the other. The temperature of the feed water into the boiler was 165 degrees F. and 123 degrees F., and the degree of super-heat was 160 and 181 degrees F., respectively.

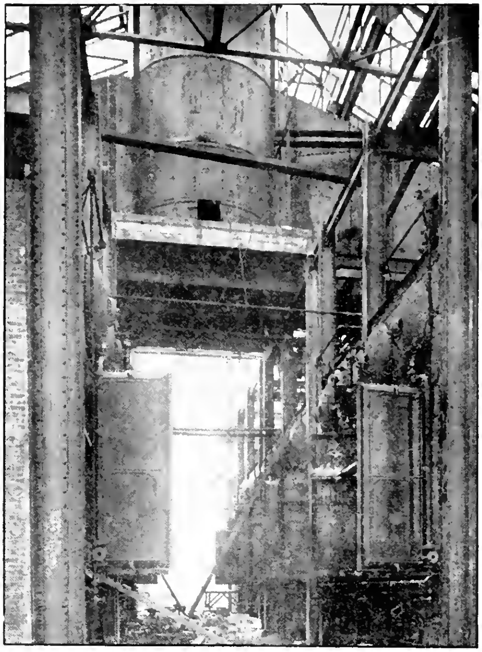
The burners are of the Owens type and a test for the amount of steam used by them was as follows: There being three burners to each boiler, 4.16 per cent of the total steam generated; 0.528 lb. of steam being required to atomize one pound of oil.

The stack is of unlined steel, and as shown on the drawing it is 125 ft. above the boiler room floor and 139 ft. above the ground. It is arranged so that this stack can be extended at any time. You will also note that the stack does not come down to the boiler room floor, thereby gaining increased floor space. The flues are of unlined steel and are also designed for extension. Provision is also made for future installation of forced draught apparatus if required under coal firing.

The dampers are hand controlled, and provision is made so that automatic attachment can be made at any

time. We also have an electric pyrometer that is going to be installed, and wiring arranged so that the temperature can be taken from each boiler uptake.

With reference to the 60 ton Shaw electrical traveling crane, and its 10 ton auxiliary hoist, there is not much that can be said. You have seen it in operation, and it has demonstrated to us its capabilities. It more than fulfilled the specified requirements on the light load tests which were made very early in the construction of this building. In this connection provision is made for removing a portion of the floor to facilitate the handling of transformers, and the condenser heads.



Boiler-Room Showing Stack Construction.

We have also installed a 1000 gallon Henry R. Worthington fire pump. It can also be used as an auxiliary feed pump. When the city water pressure is low, and when we are using city water, it is connected to the city water system and will draw from that system and deliver into the feed system. It is also available for use in case of fire around the building, and will be a necessity when this neighborhood is more thickly settled.

The feed pumps consist of one Alberger high speed, turbine driven centrifugal pump, and one Henry R. Worthington reciprocating, double acting pump.

There are also four Dow oil pumps, and two heaters installed in the basement which deliver the oil to the burners at about 80 lb. pressure. There are two Dean pumps for unloading the oil from the cars. We can unload eight cars at a time and the entire pumping operation is handled from the inside of this building. The oil is pumped into the storage tank by this method; from thence it flows by gravity into the suction of the four pumps, and from there through the heaters to the burners. We have also installed a heater at the storage tank for use in cold weather to facilitate the flowing of the oil.

We have two sources of water supply. One is from the city water, which is secondary, and two deep wells driven to a depth of about 460 feet. We have the deep well pumps operating to supply the feed water. There is a 5000 gallon tank on the roof from which this water is supplied to the hot well in the basement, thence to the suction lines of the feed pumps.

We have an air compressor installed with an operating pressure of about 70 lb. You have been introduced to both the steam and air whistles, which are used for operating purposes. The compressor is of the Westinghouse air brake type, separate reservoirs being installed for the whistle and the receiver tank. The capacity is about 55 cu. ft. at 50 lb. pressure.

We have installed here a machine shop, in which is contained motor driven tools as follows: One 24 in. x 18 ft. Fay & Scott engine lathe; one 25 in. Aurora stationery head drill; one No. 2 Bridgeport combination wet and dry grinder; one 13 in. x 10 ft. Young engine lathe; one 16 in. Smith & Mills gear and crank shaper; also a metal tool rack locker. Metal lockers are to be installed for the purpose of containing the clothing of the operators.

Most of the gauges installed in this plant are furnished by the Star Brass Manufacturing Company, except those which are provided by the separate contractors.

The flues were designed in the electrical engineer's office and were fabricated by the American Bridge Company, and as previously explained, erected by the Southern Pacific Company's bridge force.

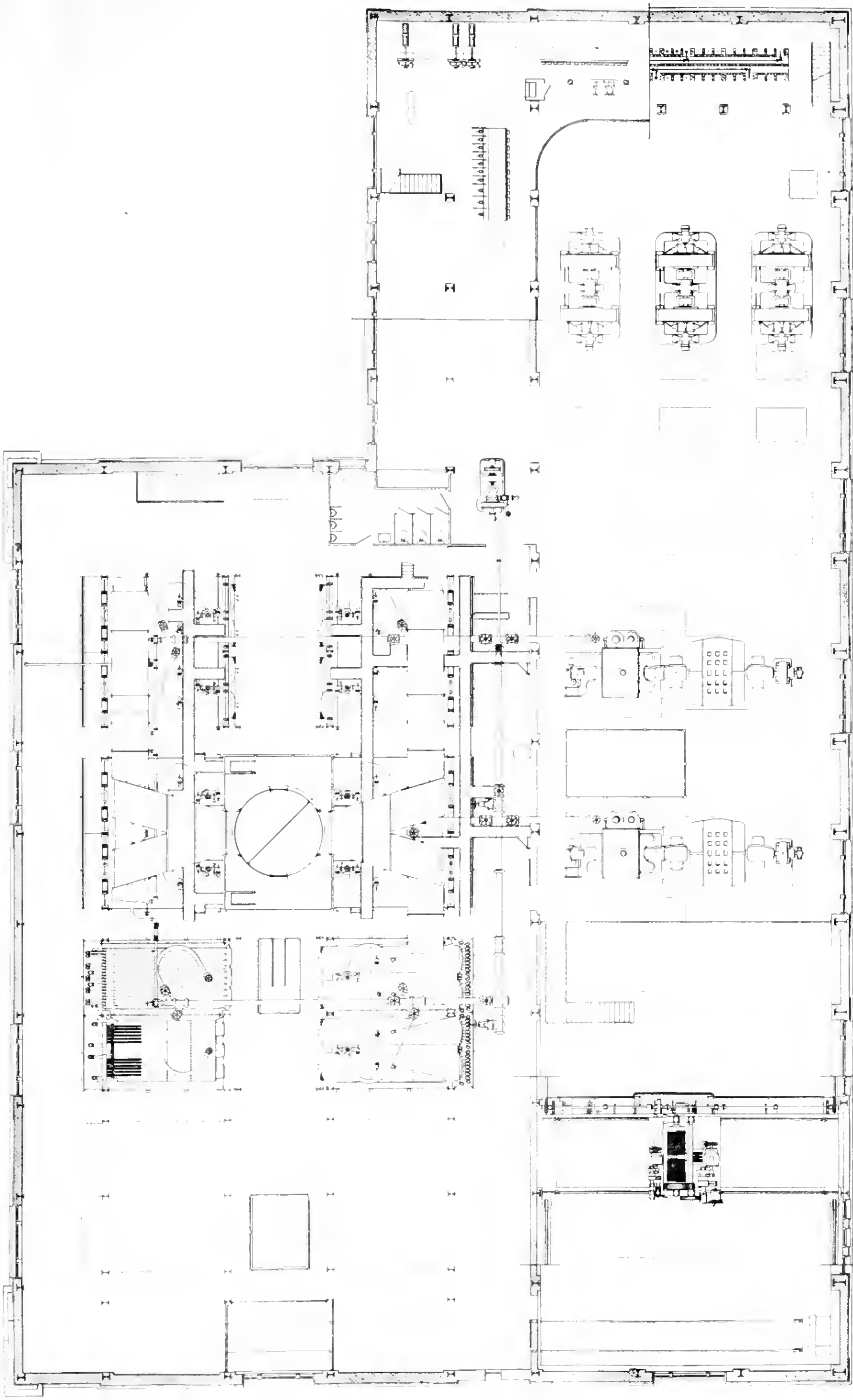
We have a closed feed water heater of the Wainwright type. It is used for saving the exhaust from the auxiliaries to heat the feed water.

We are now installing a separate system to save the discharge from the steam traps and the feed water heater condensate which is practically the only water wasted in the plant at the present moment. The condensate will be filtered and returned to the hot well. The investigation of that matter showed the desirability of returning that water which is at a much higher temperature than the water which comes from the transformer cooling system, and which is taken up to the roof and used over again. The dry vacuum pumps are of the Laidlaw-Dunn-Gordon type and are steam driven.

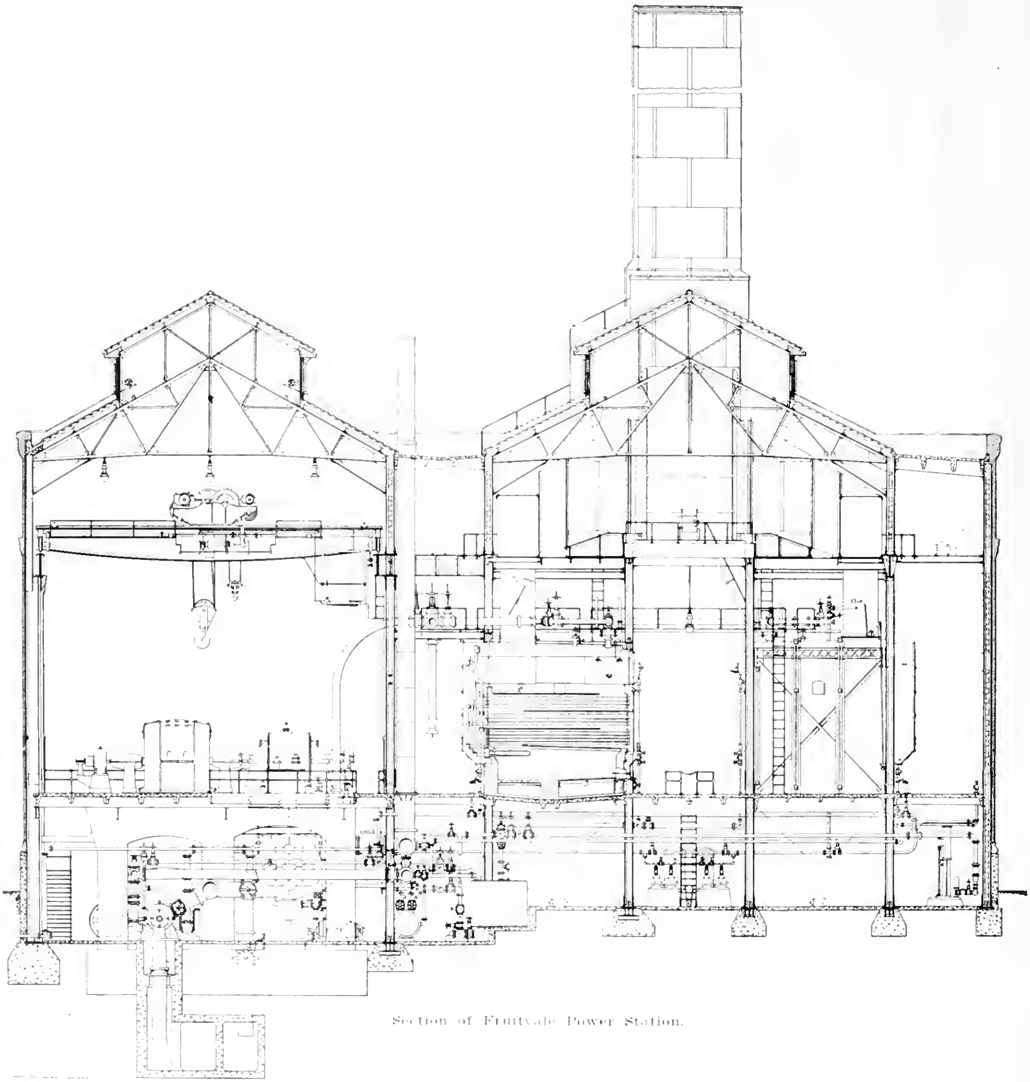
The piping of the plant was installed by the Pittsburg Valve Foundry & Construction Company. It was laid out in our office very very thoroughly. In fact the drawings that our office made were the drawings by which the piping was erected. No drawings were made by the piping contractor.

The piping systems include the main steam, the auxiliary steam, the main exhaust, auxiliary exhaust, boiler feed system, boiler blowoff water supply, lubricating piping, turbo generator gland seal, compressed air piping, and transformer oil and water system.

The pipe flanges in this building are Southern Pacific standard. They were based upon and derived from a comparative table of a number of manufacturers' design and they agree substantially with those



Plan of Fruitvale Power Station.



Section of Fruitvale Power Station.

made by well known manufacturers, but are a little heavier than those ordinarily supplied. Steam pipe flanges are of the Vanstone type generally.

The main steam valves are steel and were made by the Pittsburg valve people. The valves were all tested to 800 pounds hydraulic pressure. The main steam pipes were all erected at Pittsburg and tested out in the open to demonstrate their tightness and strength before they were shipped here.

For the operation of the power house the following forces have been laid out: The operation will be divided into three watches from 12 o'clock midnight to 8 o'clock in the morning; from 8 to 4 and from 4 to 12. On the first watch there will be a watch engineer, fireman and two oilers; on the second watch there will be a watch engineer, the water tender, fireman and two oilers, and a time and material clerk; on the third watch there will be a watch engineer, water tender, fireman and two oilers. Mr. William Redford will be superintendent of power and he was engaged as inspector during the construction period.

A. H. Babcock: Mr. Ferrier made brief mention of the fire vault lately installed in the building for the protection of our drawings, specifications and contracts. The installation of that was strongly forced upon us by our experience after the fire of 1906 in San Francisco, when there was practically nothing left in the shape of records with which we could go ahead with our business, and it occurred to some of us at that time that we better not let that occur again. This building is as near fire proof as anything can be made, and the vault is put down in the basement, so that even in the event of a general conflagration such as we had in San Francisco, it would hardly be likely that heat would

be developed sufficient to destroy the vault with its contents.

The electrical features of the plant will be taken up next by Mr. Hall. Following a rather unusual procedure detail drawings were made of the switchboard—in fact, the manufacturer was not asked to furnish any drawings whatever except those necessary to check his details. As far as possible the manufacturers' standards of construction were followed, so that there would be no difficulty in any responsible firm taking our drawings and completing the boards. We will now hear all about the electrical construction of the plant from Mr. Hall.

Electrical Details.

H. Y. Hall: As previously stated the generators are rated at 5000 k.v.a. at 40 degrees C. rise, but the actual temperature rises under 5000 kw. test were only 25.5 degrees in armature windings, 34 degrees in field windings and 34.2 degrees C. in armature iron so they will safely carry 7500 k.v.a. continuously. The air for ventilating the generators is taken from the outside of the station through screened galvanized iron ducts, but in foggy or damp weather the air can be taken from the turbine room basement, to avoid drawing moisture through the machines. The generators are star connected for 13,200 volt, 3-phase, 25 cycles, and have the neutral taps brought out for grounding, which is accomplished as shown in Fig. 2.

There are three schemes for the operation of grounded neutral systems, as exemplified by the practice of the Manhattan Railway Company, the N. Y. C. & H. R. Railway, and Southern Pacific Company. In view of the interest taken in Mr. Rhodes' paper before the Institute in San Francisco last June, it might be of interest to give a brief description of the advantages and disadvantages of the three schemes.

At the Manhattan Railway plant to prevent excessive triple harmonic cross currents between the generators only one generator at a time is connected to the ground bus. The advantage of the scheme is that the resistance between neutral and ground does not vary with the number of generators in operation, but is fixed and practically constant, thus allowing sufficient current to flow to the ground to trip the relay in case a feeder becomes grounded. The disadvantage of this scheme is that during the time consumed in transferring the ground connection from one generator to another the system is ungrounded. This scheme has proven satisfactory during seven years of service.

At the N. Y. C. plant it would be safe to operate with the neutral switches closed on all four machines if the two inter-connecting switches were open; very little cross current would flow in the neutrals. It is not advisable to operate with all neutral switches closed as there would be only 5 ohms resistance between neutral and ground, which would allow too much current to flow in case of a ground on a feeder. Two sets of resistances should be kept connected in whether there are one or more generators operating.

As will be seen from Fig. 2, the scheme being used by the Southern Pacific Company at its Fruitvale plant is the same as that used by the Manhattan Railway Company except the use of single-pole double-throw switches instead of single-pole single-throw switches for the neutrals and also the sectioning of the neutral bus. The practice will be to run with all neutral switches in the down position, except that for the grounded machine which will be in the up position. When it is desired to shift the neutral connection, the switch on the generator to be grounded is thrown up,

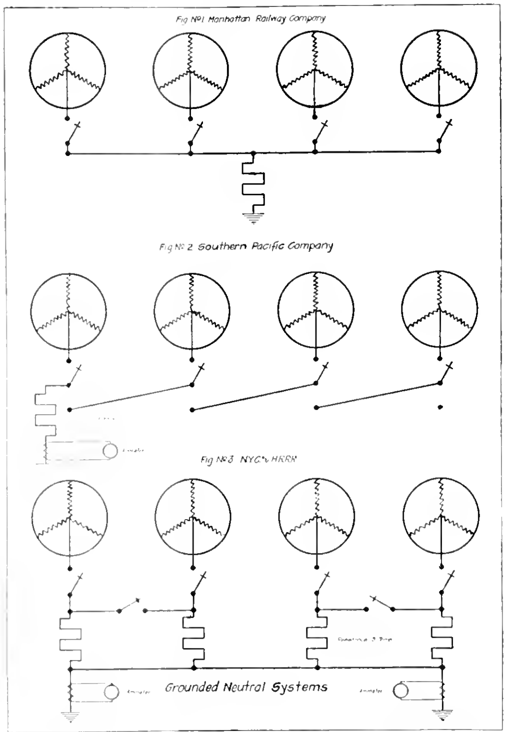
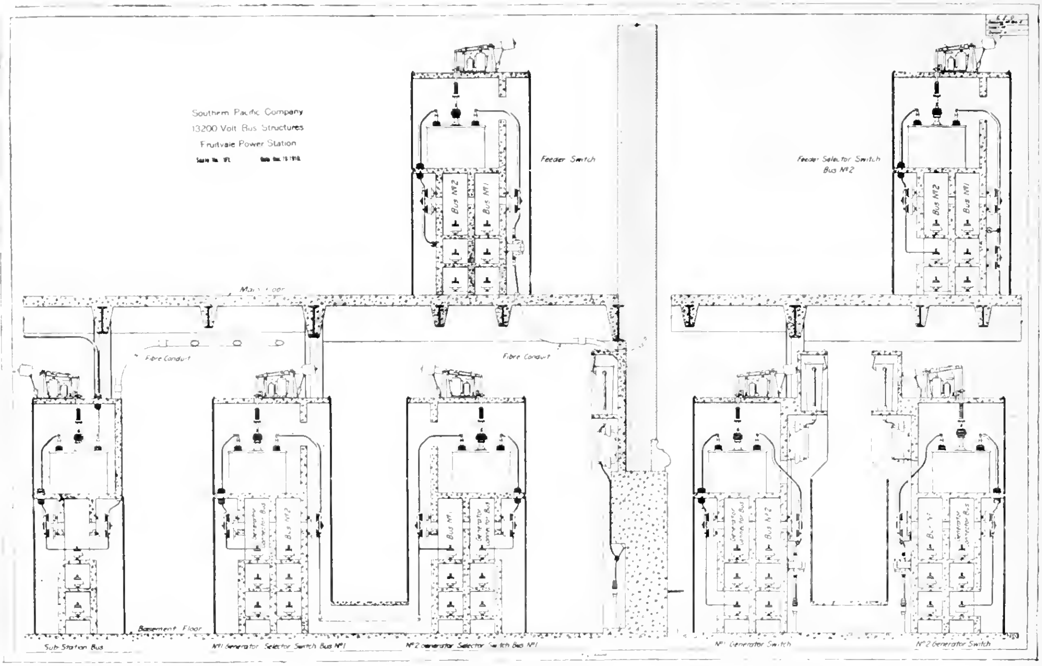


Diagram of Schemes for Operation of Grounded Neutral Systems.

after which the switch for the generator to be disconnected from ground is thrown to the down position; the system would be ungrounded during only the time it takes to throw a switch from the up to the down position. The neutral resistance is a grid type rheostat having a resistance of 13 ohms and capable of dissipating 6000 kw. for 30 seconds without injurious heating. With a dead ground on one phase of a feeder, this resistance would limit the current to 500 to 600 amperes which is sufficient to operate the automatics on the feeder; there are no automatic devices on the generators.

In connection with the installation and operation of grounded neutral systems, there is another point which should be borne in mind and that is the method of connection of potential transformers. If star connected potential transformers are used they should be connected to the neutrals of the machine, instead of to the neutral bus or the ground bus, for the neutral connection. If they are connected to the ground or neutral bus, whenever the system is running ungrounded the potential transformer voltages will be greatly unbalanced due to the difference in the loading of the poten-



13,200 Volt Bus Structures.

tial transformers. At the Port Morris plant of the N. Y. C., they have had potential transformer burnouts, due to 50 per cent over-voltage on potential transformers. The system at the time was not grounded as the operator forgot to put in the neutral switch on the machine in service. For feeders, potential transformers should be connected between phases and not to the neutral or ground.

In general, all 13,200 volt wiring in the building is run in Orangeburg fiber conduit, embedded in concrete. The generator leads and the outgoing feeders are No. 0000 single conductor cable with lead covered 14 32 varnished cambric insulation, terminating in Davis station terminals. The main generator leads are carried in conduit along the basement wall to the main generator switches.

There are two sets of 13,200 volt buses, so that by means of its main generator switch and its two selector switches any generator may be connected to either bus. The generator connector buses and main generator buses are located on the basement floor. The station is designed so that any generator or any outgoing feeder may be connected to either or both buses.

In the connections between the generator and feeder buses series transformers are placed so as to measure the total output to the substations. As shown on the diagram between the bus and each generator and also between the bus and each feeder there are two switches in series. This is made possible in the case of the feeders without the use of an excessively large number of oil switches by the adoption of the group bus system.

All 13,000 volt oil switches, bus and connections are enclosed in a concrete structure with concrete barriers between the different phases. These structures are unusually large for 13,000 volt structures and look somewhat like monuments. Originally we had planned to build structures on more conventional lines with two rows of bus structures on the basement floor and two rows of switches on the first floor, but after the steel had been erected and the building was well along, a contract was closed with the Great Western Power Co. which necessitated provision for additional oil switches. With the original plan there was just room enough for 12 generator and 12 feeder switches, so it was necessary to make a radical change and the present structure is the result, but not however, without the loss of some sleep.

The Great Western Power Company has installed temporarily on the No. 4 turbo-generator foundation a General Electric 2500 kw. frequency changer consisting of an 11,000 volt, 60 cycle synchronous motor, direct-connected to a 13,200 volt, 25 cycle generator. Its oil switches and switchboard for its 25-cycle end and for its exciter will occupy temporarily the space intended for No. 4 generator panels. A zero center scale curve-drawing wattmeter is installed to show the output from, or the input to, the 25-cycle end.

The local substation bus is located in the basement near the main generator buses. By means of two selector switches it may be connected to either main feeder bus. The outgoing 13,200 volt distribution system consists of four feeders, two of which run north through Oakland to the West Oakland substation and the other two south through Alameda to the same substation. The north, or Oakland, feeders run in conduit from the feeder bus to an outlet tower near the Fruitvale passenger station and from there run overhead

to Lake Merritt where they again go underground and run under First Street to the West Oakland substation. The south, or Alameda, feeders run to an underground switching chamber, thence by submarine cables under the estuary to a switching tower on the Alameda side, and from there overhead through Alameda and across the big towers to a point within 100 ft. of the West Oakland substation where they go underground to the substation.

As shown on the 13,200 volt wiring diagram the two Oakland feeders and the two Berkeley feeders are connected to the two center sections of the "ring bus" at the West Oakland substation, thus permitting the use of one or both of the Oakland feeders in connection with the Berkeley feeders as individual feeders for the Berkeley substation, if desired. At both substations the two Berkeley feeders can be connected together by means of the disconnecting switches, thus permitting the operation of both feeders on either oil switch or of either feeder on the other feeder's oil switch.

Provision has been made for a future high-tension transformer house located at the east end of the power station.

All 13,200 volt circuits are controlled by electrically operated Kelman oil switches. The generator, generator selector and feeder selector switches are non-automatic, while the outgoing feeder and rotary converter feeder switches are automatic.

Excitation System.

Each turbine is provided with a 125 kw., 250 volt exciter mounted on an extension of the main shaft. Each exciter has sufficient capacity to excite at least two turbines under any probable conditions of overload.

Besides the 125 kw. exciters mounted on the extension of the turbo-generator shafts, a 125 kw. General Electric steam-turbine-driven exciter is installed. On the excitation system is installed a 136-cell storage battery with a one hour capacity of 280 amp. It is charged from either of the two 250 volt buses by means of a motor-driven, 90 volt shunt booster. At present 15 plates are installed in a 27-plate lead-lined tank with provision for an increase to 23 plates, or an ultimate capacity of 440 amp. for one hour. Sixteen of the cells are end cells and are controlled by means of an electrically operated end-cell switch. The battery and the end-cell switch were furnished by the Electric Storage Battery Company.

The booster is so connected that in case the exciter from which the battery is being charged becomes disabled and the battery begins to discharge through the booster, the reversal of the current operates a reverse current relay, which throws in an electrically operated switch which shorts the booster and trips the booster breaker, thereby leaving the battery (without booster) on the excitation bus.

Substation.

The local substation is placed in an extension of the turbine room. The present installation consists of three General Electric 1500 kw. 1200 volt rotary units and transformers. Space is left for three additional units. A rotary unit is two 750 kw. 600 volt rotaries, connected permanently in series on the d. c. end, mounted on a common base and with shafts carried in a common center bearing but free to revolve independently of each other. Power is supplied by one General Electric 1500 kw. three to six-phase transformer with a double secondary winding per unit.

The transformers are the forced-oil, water-cooled type, 13,200 volts to 440 volts. They are located in a fireproof room in the basement. Removal of a reinforced concrete hatch above any transformer permits the crane to reach the transformer.

The water for cooling the transformers is taken from the tank on the roof, which is kept filled by the two deep well pumps or from the city mains. After passing through the copper cooling coils the water is discharged into the hot well, not with a view to the utilization of the negligible heat absorbed from the transformers, but to save water.

To facilitate handling, storing and treating transformer and oil switch oil and for filling and emptying transformers and oil switches, an oil system is installed in a chamber outside and at the southeast corner of the building. This room contains one clean and one dirty oil tank, each of 1800 gallon capacity, a motor driven centrifugal pump and an oil filter. Later on, we will probably install a hydrating outfit of some kind. The different tanks and pumps are connected with the transformer by pipes for handling the oil. Normally the exhaust line valve will be so set that in case of fire in a transformer the transformer valve can be opened and the oil discharged into a sump between the building and the canal.

Each transformer is equipped with a thermometer with a contact to ring a bell when the temperature reaches 55 degrees C., and also oil and water flow indicating devices with contacts to ring a bell when either stops flowing.

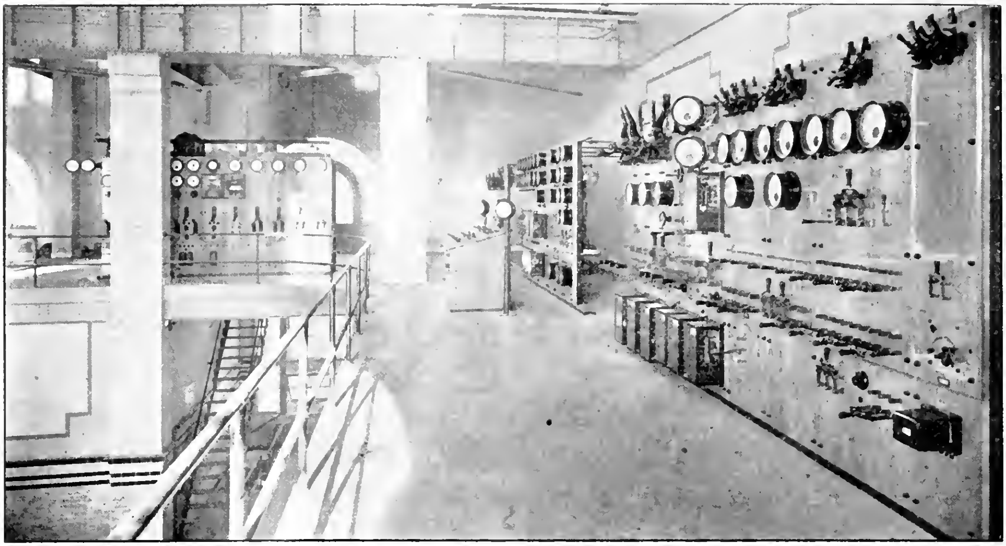
The rotaries are started from the a. c. end from one-third and two-third voltage taps on the transformers, through triple-pole, double-throw General Electric K-3 oil switches. The 440-volt switches are the triple-pole, single-throw General Electric K-2 oil switches. The operating handles of these switches, together with the field break-up switches, negative and equalizer switches and polarity indicators, are mounted on slate panels, mounted on the rotary bases.

The cast-iron rotary bases are mounted on oak insulating frames and, to limit insulation strains and to protect operators, the bases are connected through a resistance of 10 ohms to the 600 volt inter-connection between the two halves of the unit. Additional protection is afforded the operator by the installation of tile insulating floor in the substation.

The efficiencies of transformers and rotaries obtained under test were as follows:

	Transformer.	Rotary.	Combined.
1/4 Load	97.6	87.5	85.4
1/2 "	98.2	92.75	91.
3/4 "	98.1	94.5	92.7
Full "	97.9	95.5	93.6
1 1/4 "	97.6	96.	93.7
1 1/2 "	....	96.25	....

The maximum temperature rise on the rotaries under full load test was 26 degrees C. on one commutator so the rotaries will safely carry a load of 2250 kw.



Switchboard of Fruitvale Power House.

One of these rotaries has carried 4000 kw. for short intervals without injurious sparking.

During the acceptance tests on the turbo-generators, the three rotaries were loaded on the tidal canal and carried as high as 8000 kw. for one hour. The negative leads were connected to a large steel plate lying on the bottom of the canal. The five 1200 feeders were each connected to a positive plate about 60 ft. from the negative plate. These positive plates were of various shapes and dimensions but the three most satisfactory plates consisted of 8 in. wrought iron pipe about 5 ft. long. The load was varied by cutting in or out feeders and by raising or lowering the positive plates. As a further means of controlling the load a 33 ft. track rail was immersed in the water and suspended from a raft, which was anchored between the positive and negative plates or below the negative plate, depending upon the load requirements.

We found that the height of the tide greatly affected the amount of load obtainable. At low tide only 5000 kw., while at high tide 8000 kw. load could be obtained.

Switchboard.

The switchboard is placed on a gallery at the east end of the turbine room extension. The power station board is of standard construction designed in three sections, i. e., benchboard, generator and feeder instrument boards and exciter and auxiliary d. c. boards. The generator rheostats and speed-changing devices are motor-operated from the benchboard. A totalizing panel is provided for metering the total output of the generating station by means of curve-drawing watt, volt and frequency meters.

The substation 1200 volt board is installed at right angles to and near the power station board. Double-panel construction is used, with the front and the rear panels 4 ft. apart. All switches and circuit breakers are the remote-control hand-operating type. The front panels contain the instruments and switch-operating levers. The switches and circuit-breakers are mounted on the rear panels. Spare rotary and spare feeder breakers are provided, with their switches connected to the spare breaker buses mechanically interlocked so that only one rotary or feeder at a time can be connected to its respective spare breaker bus. While the angle-iron frames of the front and rear panels are insulated from ground and from each other, the station will be operated with the front frame grounded and the rear frame insulated. Soapstone slabs placed across the top between the front and the rear panels form a floor for support of the rheostats and make the rheostats, 1200 volt bus and breakers easily accessible.

The 1200 volt bus is carried in a fireproof compartment above the soapstone slabs. The rotary rheostats are mounted on the soapstone slabs above the panels. A Thompson watt-hour meter and a Westinghouse graphic recording wattmeter are installed to measure the total output of the substation. The entire switchboard was furnished by the Westinghouse Electric & Manufacturing Company.

Two 30 kw., 13,200-2300 volt Allis-Chalmers transformers furnish 25-cycle current for the operation of the local block signal system.

The station is lighted from the 250 volt excitation bus, across which a balancer set is connected to produce a three-wire system. For emergency use taps brought out from the middle cells of the storage battery are connected to a 9-point end-cell switch. The turbine and the boiler rooms are lighted by General Electric 6.5 amp. luminous arc lamps suspended from the steel work. For other lighting around the generating station building individual 16-c.p. lamps are generally installed.

The conduit, lighting, rotaries, transformers, oil switches, switchboards and wiring and cable, in fact all electrical apparatus except generators and the stor-

age battery, were installed by the company forces.

In addition to the electrical design, the installation of all electrical apparatus came under the supervision of the speaker. To F. E. Manzer, construction foreman, credit is due to the fine appearance of the cable and switchboard installation.

A. H. Babcock: The hour is getting late, but I want to give you just a brief summary of the tests of the plant up to date, and then we will start the number one turbine, and from that start the rotaries, so you can see how easily the station is handled.

At the ordinary average load of the plant, the guarantees on the boilers were 14 lb., and the performance was 16 lb.; the turbo-generator consumption on the same load was guaranteed 16.37 lb., and the performance is 15.77 lb.; the condensers were guaranteed to give 28 in. vacuum and they have given us 28½ under the extreme load condition.

The generators as I said before are within their heating limit at 7500 kw., steady load; and these rotary units are within their heating limits at 2250 kw.

It is so late now that I cannot call upon others who I know would like to say something, especially from the manufacturers' standpoint; but they will understand.

The meeting then adjourned for a general inspection of the plant.

BOOK REVIEWS.

Good Engineering Literature. By Harwood Frost. 422 pages, 5x7½ in. For sale by Chicago Book Co., 226 So. La Salle St., Chicago, and Technical Book Shop, 604 Mission St., San Francisco. Price $1.00.

The purpose of this book is clearly expressed in its sub-title, "What to read and how to write, with suggestive information on allied topics." To this task the author has brought an experience and training which eminently qualifies him to act as mentor to his less-informed brethren. In twenty-two logical chapters he gives the engineer valuable information on the design and construction of a literary production. Details as to the choice and proper arrangement of materials, in this case words and sentences, are emphasized, while those relating to mechanical construction of a periodical or book are briefly summarized. Special stress is laid upon the means of protecting and marketing the author's work. The concluding chapters show how the value of the engineer's library may be enhanced by proper indexing and filing and careful selection. This volume is more comprehensive than the usual "style sheet"; it admirably fills a long-existent void and is earnestly commended to those engineers who have something to say but lack proper means of expression.

The Principles of Scientific Management. By F. W. Taylor. 144 pages, 6x9 in. Published by Harper & Bros., New York, and for sale by Technical Book Shop, San Francisco. Price $1.50.

Herein are discussed the reasons and remedies for the prevalent inefficiency of human labor. The author has devoted years of study to this problem and cites many instances where it has been successfully solved by applying the principles of task management. This consists in giving each workman a carefully planned task for performance each day, supervising its performance and paying higher wages. It means the substitution of science for rule of thumb, co-operation for individualism, maximum output for restricted output and the development of each man to his greatest efficiency and prosperity. It places the responsibility on the manager rather than the workman and redounds to the benefit of both. While the system is not universally applicable, this book is pregnant with suggestions to every man handling manual laborers. It treats of a new and important subject in an interesting and instructive manner and is a valuable contribution to the industrial world.

Wireless Telegraph Construction for Amateurs. By A. P. Morgan. 188 pages, 5⅛x8 in. 147 illustrations. Published by D. Van Nostrand Co., New York, and for sale by Technical Book Shop, San Francisco. Price $1.50.

The object of this book is to enable any intelligent boy to construct and operate a wireless telegraph outfit. After a simple explanation of the theory of electric wave generation, transmission and reception, the author gives a detailed description of the apparatus for receiving and sending messages by the spark system. The treatment is replete with practical directions for constructing the essential parts at home and should be of great value to the tyro. Most of the information has already been published in other places, but is here assembled in compact and convenient form. While of little use to anyone who has already constructed a station, it is an admirable treatise for a beginner.

Power. By Charles E. Lucke. 316 pages, 5½x8 in. 223 illustrations. Published by The Columbia University Press of New York City, and for sale by Technical Book Shop, San Francisco. Price $2.00.

This volume comprises a series of lectures given by Professor Lucke to the students of Columbia University. In the first two chapters in a most readable style the author traces the evolution of mechanical power to the present types of machinery. Succeeding chapters are devoted to steam power, gas power and water power, in each case giving a simplified account of the principles and their application. Little or no mathematics is employed, so that the text forms an excellent introduction to more detailed study. It deals with generalities rather than specific details which are employed merely to illustrate the principles developed. It should be of especial value to the layman desirous of knowledge on this subject and to the specialist wishing a birds-eye view of approved practice in other fields. It may be briefly characterized as a history of power development.

Water power sites are taxable, according to a decision of the State tax commission of Washington. The ruling was made in answer to an inquiry by the assessor of Klickatat County. The decision follows in part: "The law reqires the assessment of all property at its full and fair value in money. A water power is not assessed as a water power, but 160 acres of land which has upon it a very desirable and valuable water power and which makes that 160 acres of land worth from four to 40 times as much as the adjoining 160 acres of land, should be assessed at from four to 40 times higher than the adjoining 160 acres."

THE APPLICATION OF ELECTRIC POWER TO LOGGING.

BY E. G. ROBINSON, JR.

The application of electric power to logging operations involves not only an electric driven yarder but also an electrically operated logging road. In the first instance the donkey engine is replaced by an electric motor while in the second instance an electric locomotive is substituted for the usual Shay engine.

A yarder is used to haul the logs from their fallen position to the railroad spur. No skid-road is built nor is there any clearing done, the log being pulled with main force and awkwardness and often butting against a stump or burrowing through a mound of earth. The rigging must be sturdy and the donkey must possess vast flexibility as to speed of cable and developed power.

Frequently a log will be bound between stumps or behind other logs, thus requiring a slow and powerful pull to dislodge it. Though the speed of the cable must be slow, the actual work done is great, as when a log comes to a dead stop on account of some obstruction the cable will often stretch 15 ft. To stretch an 1¼ in. cable 15 ft. means a tremendous pull. Such are the conditions that an electric donkey must meet with the same speed, the same strength and the same effectiveness as is now being accomplished by steam. The electric rig **must** meet every demand that the steam donkey is called upon to perform, and must do it without trouble and without hesitation.

The most feasible plan for the change is to remove the boilers and engines that are now on the present donkeys and place the motor thereon, replacing the crank disks with sprockets for a double chain drive. In placing a motor on a donkey equipped with a steam friction brake a small automatic motor driven air compressor can be installed with a storage tank and the advantages of this control can thus be retained. A donkey is worked only about one-third of the time, and so with five or six donkeys on the line the resultant peak load would not exceed 60 per cent of the sum of the peaks.

On account of the continual demand for a slow speed and heavy duty, or a large amount of power slowly applied, the writer has designed a semi-automatic variable speed gear, so that on starting a heavy load or wanting to make a slow steady pull it will give the motor a tremendous mechanical advantage. This gear ratio can be changed without a jerk and without slacking the cable or interfering with the progress of the log. The ratio can be either increased or decreased as desired within the limits of the gears. Probably with reference to the crank disks only these gears would be 3 to 1 or 2 to 1, and assuming a gear ratio of 6 to 1 from disc shaft to the heavy duty cable, this would give a maximum gear ratio of 18 to 1 an intermediate of 12 to 1 and a straight ratio of 6 to 1. These several positions are under the direct control of the donkey engineer. This variable speed gear applied to an electric donkey will cut down considerably the severe peaks that would occur on starting the donkey under heavy load. The motor would be also protected by a time limit relay so that the supply of current could be cut off at a predetermined quantity and also that the cable would not be broken when the log was immovable.

The motor capacity of an electric locomotive need not be excessive for the tonnage it will be called upon to handle. It can be comparatively small as to the service that is required on roads where the mileage per hour is high and the item of rapid acceleration of trains is essential. The maximum speed need be only from 15 to 20 miles per hour, so with comparatively small motors properly geared all desired results can be easily attained. The locomotive could be run on the main road with 6600 volts single phase, 12½ to 15 cycles, the motor to be standard series with step down transformer on the car and with standard controllers. A catenary construction is not necessary, as the speeds are low and ample insulation can be obtained with special heavy properly designed hangers. The trolley need be only a cheap, strong and insulated trolley. The locomotive also would be arranged so that the transformers on car could be automatically cut out close to the woods as the trolley line voltage would be the voltage of the donkey motors and also of the locomotive motors. The reducing of the trolley voltage here would eliminate the hazard of the high tension trolley close to the workings. The trolley could be tapped at any point for a power supply to the donkey.

One company using four donkeys, a 600-ton road engine and a smaller switching engine, all burning coal has an annual fuel bill of $19,374.54, about 39 cents per 1000 for the logs delivered to the boom. The writer believes that with the electric locomotive that the switching engine could be dispensed with as there would be no water or fuel to be delivered in the workings and no coal or fuel to be handled in the main line. There would be only one man necessary on the locomotive. This company is also pumping water from a near-by creek to a large storage tank at the camp whence the water is transferred to a tank on trucks to be delivered to the several donkeys. This pumping requires the services of one man, a boiler and pump, this having to be run 6 days a week.

In some places furnishing the donkeys with water is a very expensive item. With steam it takes two men to run the donkey, one fireman from $2.50 to $3 per day and one engineer from $3.50 to $4.00 per day, this granting that the fuel is coal or oil, and I believe either is cheaper than wood.

Where wood is burned it takes an extra man to saw the wood. The wood used is also an important item as only good sound logs suffice. Reliable data shows that it costs about $17.00 per day to run the largest donkeys using wood as fuel. This includes all labor and fuel. The freezing of water pipes in winter is a serious problem and often on starting the donkey in the morning the engineer finds that his lubricator is cracked or that his injector is broken. We all know that these things will happen with the best of night watchmen.

A man to run these motors need not be an electrician any more than the motorman on an electric car. One good lineman and a couple of helpers would be able to keep things going after once installed. A couple of new armatures could be carried in stock and could be quickly installed in case of a burn out, and the old one sent to some electric repair shop to be repaired. The variable speed gear will be built with removable sections of steel gears that can be easily and quickly

repaired should a gear be stripped or broken. Also by making the bearings of the pinion that meshes with the cone gear adjustable, a uniformly different gear rate could be secured in localities when it might be found advisable.

Though the advantages of electric logging are obvious in many respects, it might be well to make a brief summary of some of the chief points.

First and most prominent is the absence of any source of fire either from donkey or locomotive.

Second: Economy of operation. Power can be purchased from a transmission company cheaper than it can be generated with steam in many units and granting that a logging company had to install its own steam plant it would be vastly cheaper to operate one large steam plant than several small ones, especially as the collective peak load on several donkeys would not exceed 60 per cent of their individual peaks multiplied by the number of donkeys. It therefore follows that the station capacity need only be 60 per cent as large as the sum of the separate steam plants. This same steam plant could also be advantageously located as to boiler, water and fuel. It could also be run condensing and with high efficiency boilers and engines the fuel consumption could be greatly reduced.

Third: On threatening mornings instead of sending out the full crew of firemen to raise steam and wait for the weather to either get worse or improve, with the electric rig only one steam plant need be in readiness and the shaking up of one fire as the crew starts to work will have all in readiness in a brief period.

Fourth: Not having to secure water for the donkeys which is difficult and expensive in summer, while in winter there is the continual annoyance of freezing.

Fifth: One man will run a donkey, doing away with the fireman and if wood is used as fuel, it will dispense with a second man.

Sixth: The distribution of coal and handling of same and the necessary provision for its storage will be eliminated.

In conclusion it might be well to state that any logging company going into this thing should secure the services of a first-class experienced, accredited electrical engineer, as many of the problems are new and experienced and trained judgment is necessary for their proper solution. This engineer must also familiarize himself in detail as to the work in hand. In case a logging company installs its own plant strictly for logging this station equipment will be special as extra fly wheel capacity will be necessary and the generator so designed that its heating will not be excessive for brief heavy overloads.

Electrical logging is to be experimentally demonstrated at the camp of the Ebey Logging Company near Arlington, Wash., during the coming summer. Power for a series of demonstrations will be supplied by the Jim Creek Water, Light & Power Company, while the equipment will be furnished by the Westinghouse Electric & Manufacturing Company. This will consist of motor-driven 11 x 13 Humboldt Willamette yarder with a capacity for 1600 ft. of 1⅛ in. cable and several thousand feet of ⅝ in. haul back line. The motor is to be a 150 h.p. enclosed type M. W. Westinghouse, 440 volt, 3-phase, 60-cycle.

STEAM TABLES.

The accompanying tables are published through the courtesy of Chas. C. Moore & Co., engineers, San Francisco. No. 1 shows the complete plant steam con-

Assumed K.W. Hrs per Bbl. of Oil	Saturated Steam		Superheated Steam, 125°F at Boiler	
	Corresponding complete plant steam consumption — pounds steam per K.W. Hr			
	75% Boiler Eff.	80% Boiler Eff.	75% Boiler Eff.	80% Boiler Eff.
250	17 82	19.01	16.68	17.88
240	18 56	19.80	17.38	18.54
230	19.37	20.66	18.14	19 35
220	20 25	21.60	18.96	20.23
210	21 21	22.63	19.86	21.19
200	22 28	23.76	20.86	22.25
190	23.45	25.01	21.95	23.42
180	24 75	26.40	23.17	24.72
170	26 21	27.95	24.54	26.17
160	27.84	29.70	26.07	27.81
150	29 67	31.68	27 81	29.66
125	35.64	38.02	33.37	35.59
100	44.55	47.52	41 71	44 50

Table No. 1. Complete Plant Steam Consumption.

sumption in pounds of steam per kilowatt-hour from 100 to 250 with net boiler efficiencies, including stand-by losses, of 75 and 80 per cent for both saturated and super-heated steam. These are based on the assumption that there are 18,500 B.t.u. per pound of oil, 336 lb. of oil per barrel, a feed water temperature entering boiler of 180 degrees F., 175 lb. gauge steam pressure at boiler and a specific heat of .57 for superheated steam. The consumption includes steam to the prime mover, auxiliaries, oil burners and all steam losses within the plant.

Diameter of Low Pressure Cylinder	Piston Speed				
	600	700	800	900	1000
24	4 04	4.71	5.38	6.05	6.73
26	4 74	5.53	6.32	7.11	7.90
28	5.49	6.41	7.33	8 24	9.16
30	6 31	7.36	8.41	9 46	10.51
36	9 08	10.60	12.11	13.62	15.14
42	12.36	14.42	16.48	18.54	20.60
48	16.15	18.84	21.53	24.22	26.91
54	20 44	23.84	27.25	30.65	34.06
60	25 23	29.44	33.64	37.84	42.05
66	30 53	35 62	40.71	45.79	50.88
72	36.33	42.39	48.44	54 49	60.55
78	42.64	49.75	56.85	63.96	71.07
84	49 45	57.70	65 94	74.17	82.42
90	56 77	66.24	75.69	85.15	94.61

Table No. 2. Gain in Horsepower per Inch of Vacuum.

Table No. 2 shows the gain in horsepower per inch of vacuum for various cylinder diameter and piston speeds. It is calculated from a theoretical indicator card on the basis that for every inch increase in vacuum there will be an inch increase in mean effective pressure.

HAMMON OWNS MONTEREY PLANT.

W. P. Hammon has taken over the Monterey County Gas & Electric Co., which was bought some months ago in the name of F. G. Baum & Co.

Examination for Electrical Inspector in the San Francisco Department of Electricity will be held in the Commercial School on Grove near Larkin Street, Saturday, June 10, at 1:30 p. m. Applications must be personally filed with the Board of Civil Service Commissioners before 5 p. m. June 8th.

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FOUNDED 1887 AS THE
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CONTENTS

Distinctive Features of Fruitvale Power House

Power plant practice on the Pacific Coast has long been distinguished by a plainness of finish, an absence of architectural pretense, the utility of every detail for the immediate object in view, but, as a rule, a total lack of the esthetic. This seems to hold not only in plants situated in remote places but also within the cities. The practical engineer and operator seldom cares for the apparently useless expense of artistic appearance. This attitude is undoubtedly shortsighted and erroneous, but the beneficial results of artistic environment and finish are happily becoming better understood. The Fruitvale power house of the Southern Pacific Company is unique in this respect and should serve as a far-reaching example of the possibilities of inexpensive but effective treatment of form and finish, adding to the city a quasi-public building which will enhance the general appearance of the district, rather than introduce an eye-sore of the so-called mill or factory type. Symmetry in outline and harmony in coloring has been consistently followed in both the interior and the exterior. Such interior finish goes a long way towards creating an incentive for cleanliness, and this in turn is one of the greatest inducements to an interest in their work on the part of the men operating the plant.

Another feature noteworthy to the engineer and those interested in construction work is the system employed in the design and erection of this plant, enabling the work to proceed like a well-operated train schedule. To build such a plant without a mistake in fabrication, without unforseen delays or a change from the complete drawings is most remarkable. Unfortunately it is often difficult to convince owners that a system of fine detail as used here is either essential or worthy of the expense and time. In justice, however, to many plants which cannot boast of such ideal construction, a much longer period was allowed for the study of design and detail than is usually possible. In fact, most of our plants have been constructed under terrific pressure, where time is the principal element to be sacrificed to obtain service.

The electrical features of the system adopted at the Fruitvale plant are interesting in their conservatism. The problem presented is in no wise different from other tide-water plants which are to generate power to be distributed to all parts of a direct current railway network. The choice of converting apparatus, if it be rotary converters, determines the use of a low frequency for high tension distribution, but complicates the system if any dependence is to be made on local supply in case of emergency, where this supply operates at a higher frequency.

Here alternating current is generated at 25 cycles and is distributed to be converted to direct current by means of rotary converters. In view of the fact that 60 cycles has become a standard in this district and that the plant has been equipped to receive an auxiliary at this frequency, necessitating extra machinery in the form of frequency changers, the question arises as to the advisability of using this extra apparatus and generating at low frequency rather than at the prevailing frequency and converting to direct current through motor-generators.

PERSONALS.

H. W. Baum, an engineer of Denver, was a recent San Francisco visitor.

N. Ellery, the state engineer of California, with headquarters at Sacramento, is at San Francisco.

F. J. Somers, manager of Century Electric Company of San Jose, visited San Francisco during the past week.

W. G. Vincent Jr. is working with J. G. White & Co. on an appraisal of the properties of the Pacific Gas & Electric Co.

Arthur Caldwell, general manager of the California Electrical Construction Company of San Jose, recently visited San Francisco.

A. G. Wishon, general manager of the San Joaquin Light and Power Corporation, arrived at San Francisco from Fresno last Tuesday.

M. H. Dickinson, an engineer connected with steam and electric power interests at Seattle, was at San Francisco during the past week.

Hugh McPhee, district traffic superintendent of the Western Union Telegraph Company, with headquarters at Los Angeles, is at San Francisco.

Rudolph W. Van Norden has returned to San Francisco after inspecting the new Coleman plant of the Northern California Power Company which he designed.

A. A. Serva, sales manager of the Fort Wayne Electric Works, has returned to San Francisco from the Yosemite Valley and will return East by way of Portland and Seattle.

George Bell, formerly with the Westinghouse Electric & Manufacturing Company, has become associated with the Duncan Electric Manufacturing Company of Lafayette, Indiana, as sales manager.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, returned last Tuesday from a trip to the Hawaiian Islands. He used his own automobile on the Island roads.

H. H. Nohle, president of the Northern California Power Company, returned last Wednesday from a trip to the new Coleman hydroelectric plant, which is expected to start up during the summer with a capacity of 20,000 h.p.

A party of engineers, representing J. W. and W. S. Kuhn, who are engaged in a great reclamation project in the Sacramento Valley region, recently visited San Francisco in search of engineering data. P. S. Bicknell, chief engineer of the Twin Falls Land and Water Company, and I. B. Perrine, also of Twin Falls, Idaho, were among the number.

T. W. Carroll, assistant to the general manager of the Western Union Telegraph Company, spent a few days at San Francisco and left last Wednesday for an inspection of the system in the Pacific Northwest in company with C. H. Gaunt, general superintendent of the Pacific Division. He reported conditions generally favorable throughout his Western tour.

A. I. E. E. ANNUAL CONVENTION.

The annual convention of the American Institute of Electrical Engineers will be held in Chicago, Ill., June 26-30. The official headquarters will be at the Hotel Sherman, corner of Clark and Randolph streets, where the technical sessions will also be held. The following program has been arranged:

TUESDAY, JUNE 27.

Power Station Session.

10 A. M.

President's Address, by Dugald C. Jackson.

Address by President-Elect, Gano Dunn.

"Development of the Modern Central Station," by C. P. Steinmetz.

"Tests of Oil Circuit Breakers," by E. B. Merriam.

"The Use of Reactance Coils in Large Central Station Systems," by R. F. Schuchardt and E. O. Schweitzer.

Visit to Western Electric and Commonwealth Edison Companies' plants.

Electric Lighting Session.

"Depreciation as Related to Electrical Properties," by Henry Floy.

"Important Features Entering Into Making of Appraisals," by H. M. Byllesby.

WEDNESDAY, JUNE 28.

Railway Session.

"Some Data From the Operation of the Electrified Portion of the West Jersey & Seashore Railroad," by B. F. Wood.

"Analysis of Electrification," by W. S. Murray.

"Solution of Problems in Sags and Spans," by W. L. R. Robertson.

"Induction Machines for Heavy Single-Phase Motor Service," by E. F. W. Alexanderson.

Industrial Power Session.

"Automatic Motor Control for Direct-Current Motors," by Arthur C. Eastwood.

"Some Limitations of Rheostat Control," by T. E. Barnum.

"Control of High Speed Electric Elevators," by L. L. Tatum.

"Electrically Driven Reversing Rolling Mills," by Wilfred Sykes.

"Electric Vehicles," by P. D. Wagoner.

Parallel Meeting.

Telegraphy and Telephony Session.

2:30 P. M.

"Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires," by George O. Squier.

"Telegraph Transmission," by F. F. Fowle.

"Commercial Loading of Telephone Circuits in the Bell System," by B. Gherardi.

THURSDAY, JUNE 29.

High Tension Transmission Session.

"The Law of Corona and the Dielectric Strength of Air," by F. W. Peek, Jr.

"Mechanical and Electrical Characteristics of Transmission Lines," by Harold Pender and H. F. Thomson.

"Dielectric Strength of Air," by J. B. Whitehead.

"Sag Calculations for Suspended Wires," by P. H. Thomas.

"Transmission System of the Great Western Power Company," by J. P. Jollyman.

"Transmission System of Southern Power Company," by W. S. Lee.

"Transmission System of the Great Falls Power Company," by M. Hibgen.

"The High Efficiency Suspension Insulator," by A. O. Austin.

"Electric Line Oscillations," by G. Faccioli.

FRIDAY, JUNE 30.

General Session.

10 A. M.

"Economical Design of Direct-Current Electro-Magnets," by R. Wikander.

"Electrolytic Corrosion in Reinforced Concrete," by C. E. Magnusson and G. H. Smith.

"Wave Shape of Currents in an Individual Rotor Conductor," by H. Weichsel.

"The Choice of Rotor Diameter and Performance of Polyphase Induction Motors," by Theodore Hoock.

"The Application of Current Transformers in Three-Phase Circuits," by J. R. Craighead.

"The Cost of Transformer Losses," by R. W. Atkinson and E. C. Stone.

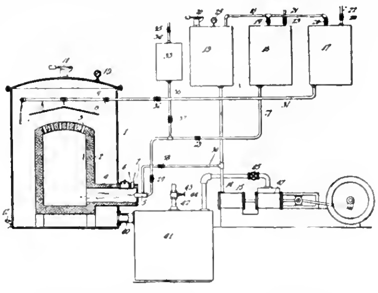
Educational Session.

"Tentative Scheme of Organization and Administration of a State University," by Ralph D. Mershon.

"Technical Education: Its Correlation with the Industries," by John Price Jackson.

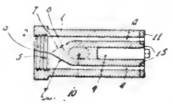
PATENTS

992,891. **Continuous Internal-Combustion Generator.** John D. Loop, Pomona, Cal. An internal combustion pressure generator comprising a casing forming an outer chamber, a shell of refractory material forming a combustion chamber witbin said outer chamber, said shell being spaced apart from the casing of the outer chamber and forming a space therebetween,



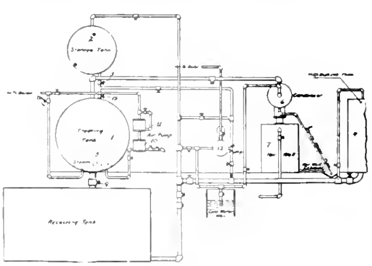
a burner provided with means for injecting oil and supplying air under pressure to the combustion chamber, a spreader plate above said combustion chamber extending beyond the shell thereof, means for supplying water to the outer chamber above the spreader plate, and means for drawing off the resultant gases under pressure from the outer chamber.

992,924. **Oil-Burner.** William H. Kelly, Los Angeles, Cal., and Silas B. Tainter, Seattle, Wash. A burner comprising a body having a central passage for elastic fluid and having an oil inlet at its rear end and provided with oil passage means extending forwardly from said oil inlet to the front of the



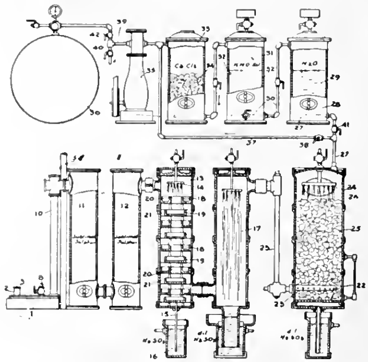
burner body, said oil passage means embracing the aforesaid central passage, and tip plate means detachably fastened to the front end of the burner body and provided with orifices communicating with the aforesaid passage for elastic fluid and with the passage means for oil.

992,918. **Process of Impregnating Wood.** Charles Stowell Smith, Berkeley, Cal. (Dedicated to the public). The herein described process of preserving wood which consists in introducing the wood into an air tight cylinder, subjecting the



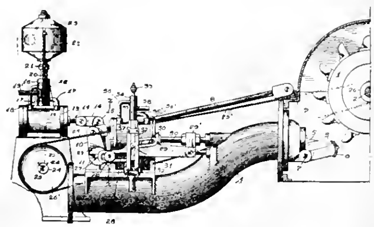
wood in said cylinder to the action of the bath of oil at approximately 220 degrees F. for a length of time sufficient to heat up the wood and thereby vaporize most of the water contained in the wood, then drawing off the oil and applying an air pressure of about 50 pounds per square inch, introducing a preservative oil at approximately 120 degrees F. and raising the pressure to about 157 pounds per square inch, for a length of time sufficient to insure the desired impregnation, then relieving the pressure and simultaneously drawing off the unabsorbed oil and then subjecting the wood to a vacuum for the purpose of drawing out a portion of the oil from the cell cavities.

992,017. **Apparatus for Obtaining Nitrogen From Air.** Charles Blagburn, San Francisco, Cal. An apparatus for obtaining nitrogen from atmospheric air consisting of a furnace of considerable area in proportion to its height to expose a large body of sulfur to oxidation and so concentrated as to



compel the whole of the air supplied to said sulfur to flow into contact with the sulfur in the furnace, means for supplying sulfur and air at one and of said furnace, a conduit at the other end of said furnace for the resulting gases, means for removing from said gases the sublimated sulfur, means for washing from said gases the sulfurous acid, and means for confining the residual nitrogen, substantially as described.

993,064. **Automatic Control for Hydraulic Nozzles.** George J. Henry, Jr., San Francisco, Cal., assignor of one-half to The Pelton Water Wheel Company. In combination with a water wheel, a rigid nozzle, a needle valve therein for controlling the outlet orifice thereof, and a deflecting hood arranged to swing in advance of the nozzle for the purpose set forth, of



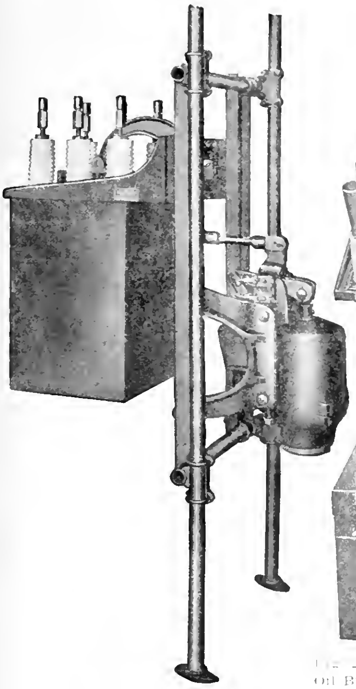
a motor for the hood, a governor actuated valve for controlling the motor, connections between the motor and hood, a motor for the needle valve, a valve for the motor, means actuated by the aforesaid connections for shifting said motor valve, said means being connected to the needle valve and comprising provision for restoring said valve to normal position and bringing the needle valve to rest, as set forth.

INDUSTRIAL

NEW TYPE OF OIL BREAK SWITCH.

A new type of oil break switch has lately been placed on the market by the General Electric Company for use on circuits where the potential does not exceed 15,000 volts. A straight line operating mechanism is employed, which, with the exception of the operating lever and its connecting link, is entirely mounted upon the switch frame. This mechanism gives a vertical parallel movement to the movable contact blades and both obviate the danger of friction or binding and increases the speed of the switch break. This mechanism is adjusted at the factory and requires no further adjustment.

The fixed contacts are of the well-known drop forged copper, flared finger type. The movable contacts are wedge shaped copper blades, each provided with a slot in the upper extremity, permitting a jet of oil to be forced into the arc on rupturing the circuit. This assists in extinguishing the arc quickly and reduces the disturbance in the oil vessel.



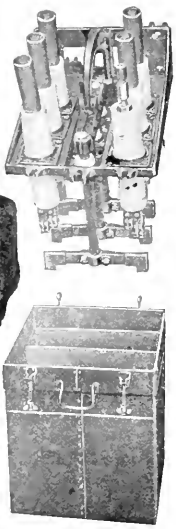


Fig. 2. K-12 300 Ampere Oil Break Switch.

Fig. 1. K-12 Solenoid Operated Oil Break Switch.

This construction, insures clean contact surface and good contact under pressure over the entire surface and also prevents burning and pitting the contact surfaces, inasmuch as the arc is not ruptured between the actual contact surfaces but between the upper extremity of the moving contact and the flared portion of the stationary contact.

The insulators are of one-piece glazed porcelain of the highest grade, corrugated to give large creepage surface. Each insulator extends below the oil level and is clamped to the frame by two metal plates and four cap screws, eliminating the use of babbitt or cement. The insulators are interchangeable.

The switch being a self-contained unit is conveniently handled and installed without interfering with the alignment. The arrangement of terminals employed saves time and labor in installing or disconnecting.

In the form K-12 oil break switch, greater striking, and arc-over distances, greater oil and greater air spaces are secured. The type F form K-12 oil break switches are made single, double, triple and four-pole for mounting on panel, on panel pipe supports, on frame work remote from panel, or in masonry cells.

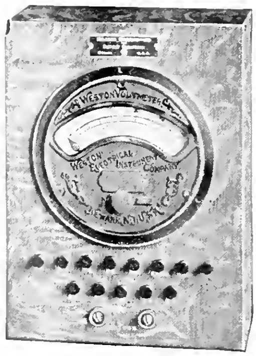
They can be supplied either hand or solenoid. The automatic switches can be arranged to operate on low voltage, reverse current and the like. Bulletin 4821 gives a complete description of the switch.

KELLOGG NEW TESTING CABINET.

The testing cabinet illustrated herewith has been designed for use in connection with small exchanges. It affords a means for making reliable tests of trouble that arises in equipment of this type. Practically the same tests can be made with this cabinet as with our more elaborate wire chief's desk.

The cabinet containing the apparatus in the testing circuit is $13\frac{1}{2}$ in. high, 10 in. wide, and 6 in. deep and is substantially made of quarter-sawed oak and gives a golden oak finish. A Weston round pattern voltmeter is mounted in the front directly above the keys. Two connectors are located below the keys for connecting to a Wheatstone bridge.

The advantage of a compact testing cabinet of this type is, that it may be mounted on the end of the switchboard section within easy reach of the subscriber's line equipment.



Kellogg Testing Cabinet.

Tests which can be made with the testing cabinet are as follows: Location of grounds on a subscriber's line, short circuits, crosses between two subscribers' lines, foreign currents, opens, cross talk, earth currents, insulation, swinging, grounds, receiver off of hook, resistance of drop coils, receivers, etc., voltage of dry or storage cells.

A set of instructions is furnished with each testing cabinet which fully describes the method of making tests.

The apparatus included in the test panel consists of: A Weston No. 24 round pattern flush type voltmeter scale 0-50 volts with a 10,000 ohm coil, and the necessary keys for making the tests previously outlined. The operator's telephone consists of a desk stand complete with operator's receiver, head band, cord and induction coil. If desired, a

breast plate operator's set instead of that described above, will be furnished.

A flexible two-conductor testing cord, and a single conductor grounding cord is provided, if the testing set is for a Kellogg switchboard and if ordered otherwise, the set will be shipped without cords. Each of Kellogg cords will be eight feet in length. With this testing cord attached to a switchboard plug, it is possible to reach any subscriber's line equipment in a three-position switchboard.

If it is desirable to locate the testing cabinet in the terminal room it is only necessary to connect the cord connectors of the testing cabinet with the cord fasteners of any vacant cord in the switchboard, by means of a twisted pair of wires.

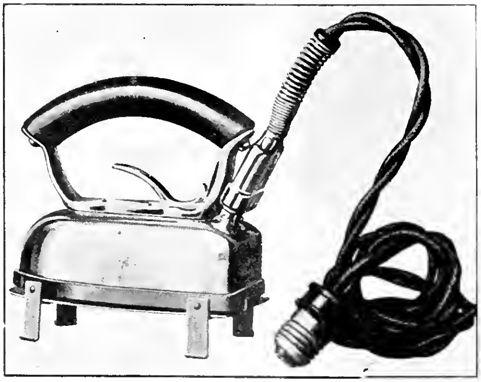
To make tests from the main distributing frame or terminal rack, a twisted pair of wires are connected to the binding posts in the testing cabinet and run to a pair of suitable connectors located near the distributing frame. A flexible four-conductor cord or wires (with an arrester plug attached to one end, if of the heat coil type) are used to complete the connection between the connectors and the arresters on the distributing frame.

With the connections completed as described, it is possible to test either in through the switchboard or out on the line. This cord and plug is not furnished unless called for extra and then only in case the arresters are of our No. 1 make or of some other standard make where the manufacturers of same carry a stock test plug.

THE TRAVELER'S ELECTRIC IRON.

Often the traveler has occasion to do light pressing in his or her room. Creases in garments must be eliminated, the effects of damp weather must be removed and often dainty linen must be pressed. An electric iron is invaluable for these services but, for the traveler, an iron should be so designed that it can be packed readily and it must be thoroughly reliable.

The Westinghouse electric traveler's iron has three qualifications. The handle can be removed so that a minimum of packing space is necessary. The heating element is enclosed, under enormous pressure, between the bottom ironing face and a top casting which constitutes a heat reservoir and which is thermally insulated from the sheet metal cover by an air space. This construction prevents oxidization of the element, hence it will last indefinitely.



Westinghouse Electric Iron for Travelers.

A noteworthy feature of this iron is that no breakable material enters into its construction. Porcelain, lava, or moulded asbestos, all of which are brittle, are sometimes used in electric irons, or in the connecting plugs. None of these materials is used in the Westinghouse iron or in its plug. All insulation is of sheet mica and the connecting plug is composed wholly of metal and sheet mica.

A hole is provided in the end of the iron, in which a curling iron can be heated. A durable stand, formed from sheet metal, is furnished with each outfit.

TRADE NOTES.

F. C. Finkle, consulting engineer, announces the removal of his offices from 628½ South Spring Street to 448-9 J. W. Hellman Bldg., Los Angeles, Cal.

R. J. Davis, Pacific Coast representative, Century Electric Company of St. Louis, Mo., has opened an office at Los Angeles, 220 Lissner Bldg., in charge of P. A. Shelton.

On June 1, 1911, the Fort Wayne Electric Works will be merged with the General Electric Company of Schenectady, N. Y. Its business will be conducted under the name of Fort Wayne Electric Works of General Electric Company. The same lines of apparatus and supplies will continue to be manufactured and sold under the immediate direction of the same individuals as heretofore, with Mr. F. S. Hunting in responsible charge as general manager. The branch office of the Fort Wayne Electric Works of General Electric Company will be continued as heretofore.

NEW CATALOGUES.

Direct Current Grinders and Buffers for machine shop use are illustrated and described in Bulletin No.1127 from the Fort Wayne Electric Works.

Bulletin No. 1128 from the Fort Wayne Electric Works is devoted to Multiphase Induction Motors with either riveted or skeleton frames for all services.

Type K 3 Multiphase Induction Watthour Meters are illustrated and described in Bulletin No. 1129 from the Fort Wayne Electric Works. Full details as to construction and connections are given.

Instruction Book No. 3048 from the Fort Wayne Electric Works is concerned with their Type A Form A Oil Transformers. The illustration and text give valuable suggestions on the installation and connections of transformers.

"Practical Operation of Arc Lamps," edited and published by the National Carbon Company of Cleveland, Ohio, contains 76 pages of practical points regarding arc lamp construction and operation. A number of practical tables and a complete index are also given.

Bulletin 13 A from the engineering department of the National Electric Lamp Association gives information whereby any lamp user can select the correct lamp for his needs and technical data on the performance and characteristics of Mazda multiple lamps with drawn wire filaments.

MEETING OF PACIFIC NORTHWEST SOCIETY OF ENGINEERS.

The annual meeting of the Pacific Northwest Society of Engineers will be held at Seattle, Wash., on June 6 and 7. President A. H. Dimmock will speak on "The Place of the Civil Engineer in Modern Civilization." State Geologist Henry Landes will discuss "The Work of the State Geological Survey," and Captain A. O. Powell will talk on "Centralization of State Engineering Work." A dinner will be given at the Commercial Club rooms, followed by an illustrated lecture on the Panama Canal by A. W. Munster. The members will visit the White river-Lake Tapps hydro-electric power plant where they will be the guests of the Pacific Coast Power Company, of which S. L. Shuffleton, Northwest manager of the Stone-Webster Company, is the chief engineer.

NEWS NOTES

FINANCIAL.

BREWESTER, WASH.—An election will be called soon to vote on bonding the town for $7500 to install a municipal water system.

ASHLAND, ORE.—The voters of Ashland have voted down a proposition to issue $27,000 water bonds for the extension and repair of the water system in that city.

WALLA WALLA, WASH.—The Pacific Power & Light Company has purchased the entire holdings and local plant of the Waitsburg Electric Light Company, at about $45,000.

BEACH, CAL.—Qualified voters of the city will hold an election June 27, to vote on the question of issuing bonds in the amount of $850,000 for the purchase of the two private water plants.

LOS ANGELES, CAL.—Certificate of change of principal place of business has been filed by the Bakersfield and Kern Electric Railway Company, from the city of Bakersfield to the city of Los Angeles.

INCORPORATIONS.

BAKERSFIELD, CAL.—Bakersfield & Kern Electric Railway Co. Capital stock, $250,000; subscribed, $5000. Directors, C. R. Eager, S. B. Cushing, H. A. Blodgett, F. T. Whorff, C. N. Beal.

RED BLUFF, CAL.—The Oro Electric Company has been incorporated for $10,000,000, shares $100 each, subscribed $7000 by F. V. Pering, F. S. McAllister, W. B. Phelps, W. S. Wilsey, A. Harvey, E. Buckhaley and W. G. Jack of San Francisco

CENTRALIA, WASH.—The Centralia Electric Light & Traction Company has been incorporated by Walter Copping, G. W. Muck, N. W. Mills. It is the intention of the new company to construct an electric street railway between this place and Rochester, a distance of 15 miles. Practically all of the right-of-way has been secured. The company will also supply power and electric lighting to farmers along the route.

ILLUMINATION.

ELLENSBURG, WASH.—W. W. Seymour in a communication to the City Council asked that his gas franchise be extended for another year.

OREGON CITY, ORE. The acceptance by A. L. Beatie of the ordinance granting him a franchise to lay gas mains in Oregon City has been filed.

KINGMAN, ARIZ.—The Kingman Gas Company has secured an option on a site for a gas plant to be installed for the purpose of furnishing fuel gas to residents of the town.

PROSSER, WASH.—The county commissioners have granted the Pacific Power & Light Company a 50-year franchise for the transmission of electric power in Benton county.

SANTA ANA, CAL.—The Board of Supervisors has sold a franchise for a pipe line to the Southern Gas Company, the bid of C. S. S. Forney, representing the company of $1000 being accepted.

KLAMATH FALLS, ORE.—The W. F. Boardman Company of San Francisco, is seeking a fifty-year franchise for the erection and operation of a gas plant in Klamath Falls. The company agrees to put in a plant with a capacity for 25,000 population, and agrees to begin the installation of the plant within 60 days from date of signing of the ordinance. The company will expend $65,000 in the installation of this plant.

COULEE CITY, WASH.—The Council has passed an ordinance granting to the Pacific Power & Light Company a franchise to construct and operate electric light and power lines in the streets of the town.

WHITTIER, CAL.—The Board of Trustees of the Whittier Union High School are receiving sealed bids for furnishing electrical fixtures for the Science Hall. Bidders may furnish their own specifications.

COLTON, CAL.—The City Council has awarded a contract to the General Electric Company, Los Angeles, for a 100-kilowatt transformer for $543. It will be ordered at once as it is wanted for service in the carnival.

SAN FRANCISCO, CAL.—The bid of Thomas Day Company of San Francisco to install the lighting fixtures in the addition to the Federal building in Sacramento has been accepted by the Treasury Department. The contract amounts to $2171.

PASADENA, CAL.—Notice is given that the city clerk will receive sealed bids up to June 6, for furnishing a turbo-generator unit with Tirrill regulator and exciter, together with condenser pumps and auxiliaries of capacity of 1500 to 1650 kilowatts.

MADERA, CAL.—F. C. Roberts Company bid $100 for a gas franchise, the company agreeing to file plans and specifications with the cost of installation, giving the city the right to purchase the plant at any time within the life of the franchise at cost and 8 per cent interest on the investment.

GREENVILLE, CAL.—Negotiations have been completed whereby the Indian Valley Light & Power Company has acquired the Dunn water right on the Feather River near Seneca. It is estimated this water will generate 25,000 h.p. of electric force. S P. Dunn, who controlled the water right for seven years becomes interested in the Indian Valley company. A survey for the ditch and a transmission line to Greenville will be completed within a month, and it is expected that the plans for the power plant will be completed within the same space of time. The capital stock of the company has been increased to $500,000 and the enlarging of the company's plant has been fully financed. The construction of the power plant will be commenced in a short time.

LOS ANGELES, CAL.—Alleging that the assessor was guilty of "fraudulent discrimination" in placing a valuation upon its franchises, the Los Angeles Gas & Electric Corporation has filed suit to recover $24,830.13 from the city, that amount having been paid on a tax levy under protest. The pleadings assert that this company was assessed on a valuation of $2,989,065, while the value placed on the franchises of the Domestic Gas Company, was $49,450. The Economic Gas Company escaped with paying taxes on $100. One of the allegations is that the company was assessed on its "good will." This is declared to be discrimination in that 10,000 business houses were not taxed upon the "good will." It is averred that in the cases of other corporations, the stock was taken at its market value, while an arbitrary value of $150 a share was put on the gas company stock. It is asserted that it had a value of only $100 per share . The pleadings do not intimate any mistake on the part of the assesser, but openly charge him with having wilfully discriminated against the corporation. The company admits that its property should have been assessed at $1,203,065 and that its taxes should have been $16,667.64, but alleges that the action of the assessor has made the entire levy invalid so far as it is concerned.

TRANSMISSION.

HOPE, IDAHO.—This place has granted the Northern Idaho & Montana Power Company, a franchise for power and lighting service on the streets here. Work will soon start on a 14-mile power line.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing officer, Isthmian Canal Commission, up to June 15, for furnishing trunions, line materials, insulators, copper wire, crossarms, etc. Circular 633. Form of bid on file at U. S. engineer's office, Chronicle Buiding, San Francisco.

MADERA, CAL.—The wires of the San Joaquin Light & Power Company are to be extended from Madera to Los Banos, Gustine, Dos Palos, Mendota, and Firebaugh. The announcement of the intention to invade the west side of this section of the San Joaquin Valley was made by Manager A. G. Wishon.

LOS ANGELES, CAL.—The bureau of power development has stated that two million dollars more will be necessary during the next fiscal year. Unless this amount is forthcoming it will be impossible to have the power in Los Angeles by December 31, 1912, when it is expected the aqueduct will be completed. The money is to be used for the Fairmount dam, to construct tunnels and other hydraulic work in San Fransquito canyon.

MEDFORD, ORE.—The Klamath Power Company has entered the field in competition with the Gold Ray Electric Company. A franchise for the use of the public highways has been granted the company in Josephine county and a similar franchise was granted in Jackson county, last week. The company intends its lines to be extended over the entire valley as far north as Grants Pass and will also connect with all the smaller towns.

BOISE, IDAHO.—The Secretary of the Interior has awarded the following electric apparatus contracts on the Arrow Rock dam in the Boise irrigation project, as follows: The Allis-Chalmers Company of Milwaukee, Wis., 3 alternators, 4 auxiliary transformers, and air compressor, contract price. $19,450. The Westinghouse Electric & Manufacturing Co., of East Pittsburg, Pa., 3 air blast transformers and 2 blowers, contract price $5880. The General Electric Co., of Schenectady, N. Y., switchboard, 24 disc switches, 6 electric circuit breakers, supplies, and 2 lightning arresters, contract price $6056.

RENO, NEV.—The Truckee River General Electric, one of the Hammon projects, has commenced a suit against a number of farmers in the Truckee Valley for the condemnation of rights of way over their lands for a high voltage power transmission line, to run from the new electric power plant being built at Verdi, to Wabuska. F. E. Durham and D. C. Wheeler are two of the prominent land owners sued. The company is rushing construction work on its new generating plant. Water is to be taken from the Truckee River at Verdi and carried to a point two miles below town through a ditch 36 feet wide and 8 feet deep. Through a penstock 2100 feet long the water will be dropped 85 feet to the turbines. The plant will consist of one generator that will develop about 3200 h.p., which is to be supplied to consumers at Mason, Nev., and the surrounding country for power and lighting purposes. This plant, under favorable conditions, will be ready for operation by September 1.

TRANSPORTATION.

SAN FRANCISCO, CAL. Three authorizations to pay for material and work on the municipal street railway on Geary street have been finally passed by the Supervisors as follows: McNab & Smith $4517.33 for hauling steel rails; Board of Works, $2000, for hauling and piling cross-ties, Pennsylvania Steel Company, $12,629.50, for steel rails.

OAKLAND, CAL.—The Oakland Traction Company has been awarded franchises for street railways on East Sixteenth street or the Boulevard and on Fourteenth avenue and Hopkins streets. Both franchises are for 35 years.

TURLOCK, CAL.—The Tide Water & Southern Railroad Company has made application to the Board of Trustees for a franchise to construct and operate an electric railroad track of standard gauge, to be constructed between this city and Stockton. The application will come for hearing on June 27th.

FRESNO, CAL.—Plans have been completed by H. A. Hansen for the office building of the Fresno, Hanford & Summit Lake Railroad, to be located on I street in this city. The building, which will cost $20,000 will occupy two lots, 50x150. It will have a two-story front but will be only one story in height in the rear. The General Electric Company has completed the ground floor plans of the power station of the railroad company.

OAKLAND, CAL.—An ordinance granting the Oakland & Bay Shore Railroad Company, a subsidiary company of the Oakland & Antioch Railroad Company, a franchise in Shafter avenue, has been passed to print this week by the City Council. The action was taken in spite of an opinion by Ben F. Woolner, city attorney, that the council probably had no jurisdiction over the application to lay rails in Shafter avenue to Thirty-eighth street. The franchise grant was only to Fortieth street.

MODESTO, CAL.—The Modesto trustees have passed to print the franchise for the Tidewater Southern Electric Railway. The "exclusive" clause that has been the principal bone of contention, was dropped by the promoters when the trustees agreed that a clause would be inserted in the franchise allowing the Tidewater Southern Railway Company any privileges that any time in the future may be allowed other companies building on the same streets. The action has now made it possible for the company to continue with their road from Escalon as soon as desired.

WATSONVILLE, CAL.—A contract for the building of a concrete wharf at Port Watsonville to extend 1700 feet into the water has been let by the Watsonville Railway & Navigation Company to the Marine Concrete Construction Company of San Francisco at a figure close to $50,000. W. F. Crosby, traffic manager of the company, announces that all of the property holdings of R. W. Eaton at Port Watsonville have been purchased by the railroad company and that the company has a number of plans in view for improving the property. He states also that a regular line of steamers will be in operation within 60 days, running up and down the Coast. The extension of the electric lines through the Pajaro Valley will also begin soon, putting the company in a position to handle a large volume of freight during the coming fruit season.

TELEPHONE AND TELEGRAPH.

NEWPORT WASH.—W. C. Hickman, of Spokane, superintendent of construction of the Pacific States Telephone & Telegraph Company in this territory, has recently investigated prospects for extensions of the company's line from Newport to Metaline Falls.

BAKERSFIELD, CAL.—J. W. Kelly, who is promoting a local telephone company, says he has $50,000 in capital pledged to the enterprise and he expects to make application for a franchise at the next regular meeting of the city trustees. Mr. Kelly declines to make public the names of his associates in the venture, but says that they are all local people. Ultimately, however it is the expectation that long distance service will be provided by means of a through wire connecting the Home telephone systems of San Francisco and Los Angeles.

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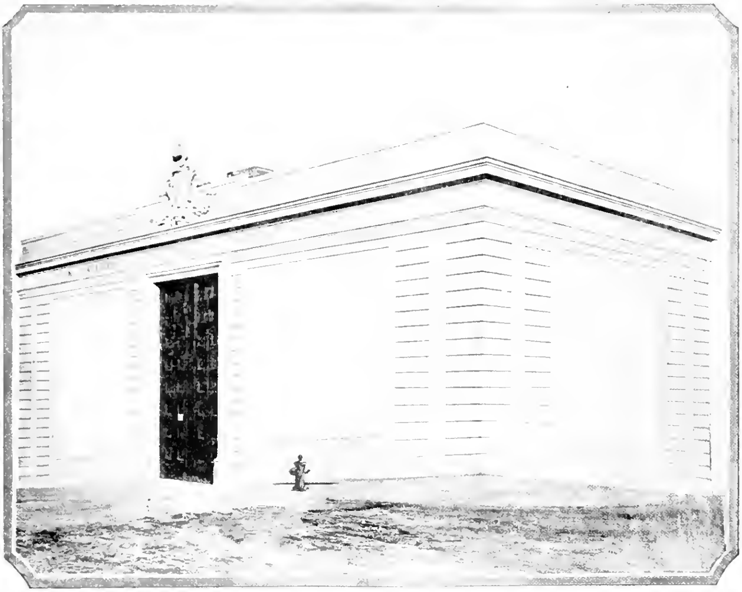
STATION "G," SAN FRANCISCO

BY C. F. ADAMS.[1]

Out in the district north of Golden Gate Park a temporary substation was built four years ago. San Francisco emerging from many ashes and some sackcloth would have amusement and the Chutes Park wanted light and power. A residence district also was building which required service.

To follow this shifting population the Chutes Park has moved to Fillmore street, and its old leased location has been sold to home builders. Thus it came that the Chutes substation was obsolete and required a new and more effective location. A careful survey was made of the territory west of Fillmore street, and a



Exterior Station G.

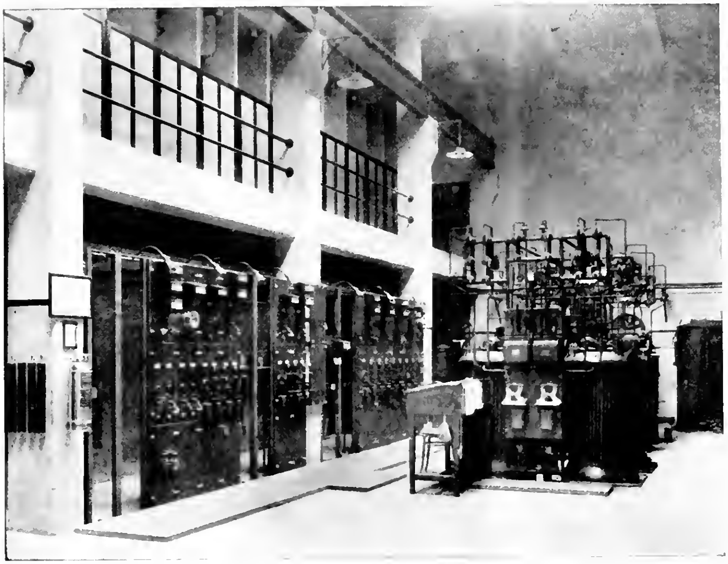
location was finally secured on the northeast corner of Ellis and Broderick streets. This was in a residential section and plans were drawn for a station that would not be out of harmony with its surroundings.

Four years ago a prophecy as to the city's future was by no means unanimous, and temporary construction was sometimes advisable. With this in mind a steel frame and galvanized steel structure was erected, large enough to supply present local conditions. In the four years that have elapsed, changes were many. Van Ness avenue has ceased to be a business street, the down-town district having been rebuilt and reoccupied. The congestion in and about Fillmore street has been relieved, and the entire center of population has shifted. Also the load center of the gas and electric service has shifted.

The station is unique in some respects. It does not contain a single window in its four concrete walls, light and ventilation being obtained from a long overhead skylight and louvre. A large panelled oak door is the central feature of the front wall. The architectural design is pleasing and is well pictured in the illustrations.

The building is constructed of reinforced concrete throughout. Within the building every convenience is provided for the safe control of the equipment. A

[1]Engineer of Electric Construction, Pacific Gas and Electric Company.



Main floor showing switchboard and voltage regulators.

Subway beneath switchboard.

gallery supports the concrete switch cells which contain the 11,000-volt bus, oil switches, and current transformers. A twenty-ton traveling crane spans the main floor and permits quick removal of any heavy apparatus. The switchboard is on the main floor along the line of gallery columns. The 2300-volt two-phase switching equipment and bus is beneath the gallery floor and directly back of switchboard. A roomy subway gives access to all the operating mechanisms, cable and conduit outlets. Three thousand kilowatts capacity of transformers is at present installed with voltage regulators for four circuits.

TRANSMISSION APPLIED TO IRRIGATION.[1]

BY O. H. ENSIGN AND J. M. GAYLORD

The subject of transmission applied to irrigation covers a very broad field of electrical, hydraulic and mechanical engineering. It presents problems of finance and agriculture and must also be viewed from the humanitarian standpoint. There are a number of distinct conditions which lead to the use of transmitted power for pumping in connection with irrigation projects. The more important of these conditions are the following:

1. In some cases high lands which can not be reached by the diversion works constructed for a gravity system can be reached by pumping water from the gravity canals into canals feeding such high land areas.

2. The irrigated area may be advantageously extended by pumping from wells, thus drawing on the underground sources and tending to keep the water plane down, this plan being particularly desirable in certain cases, as will be explained farther on in this article.

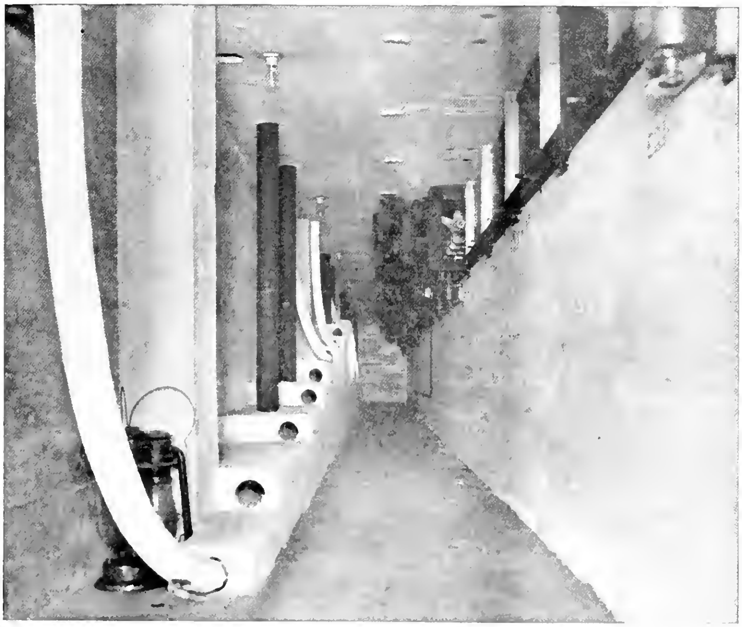
3. Pumping may also be applied to the drainage of low land, water being pumped to either irrigation or waste ditches.

In connection with the diversion works, it frequently occurs that a considerable amount of hydraulic power can be developed.

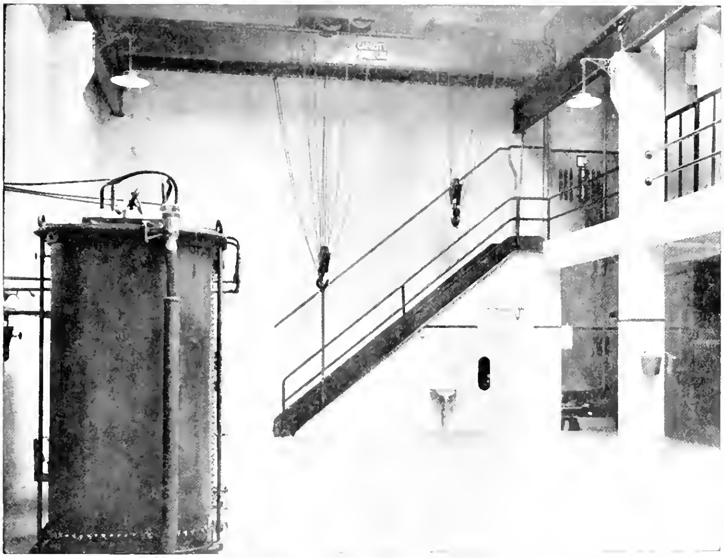
This paper will be devoted mainly to the discussion of a hydroelectric transmission system constructed by the Reclamation Service applied to the irrigation of high lands by pumping from gravity canals.

It may not be inappropriate in this discussion to call attention to the advantages of pumping the ground waters of an irrigated area. The advantages of such a plan are, first, to prevent the rise of the ground waters to a point dangerously near the surface and, second, to supplement by means of drawing on the underground supplies the water stored in the reservoir or diverted from the natural flow of the streams.

[1]Abstract from paper presented at the Pacific Coast Meeting of the American Institute of Electrical Engineers, Los Angeles, April 25-28, 1911.



Passageway back of switch-cells, showing cable outlets and switch operators



North end of station, showing gallery stairway.

The rise of the ground waters damages the land in an arid climate by allowing evaporation to take place from the surface or from near the surface of the ground, thus increasing the amount of deleterious salts in the surface soil, gradually causing the land to become alkaline in character and non-productive, hence it is essential that the water plane should not rise beyond a certain limit.

It may generally be considered that the thorough watering for irrigation purposes of a large area of land which heretofore has been drained by the rivers which have flowed through it will tend more or less to cause a rise of the ground waters, hence the importance of this particular phase of irrigation.

In some cases the natural underground drainage may be such that the rise of the water plane will be limited to a reasonable depth below the surface, but there are many examples in the West where this has not been the case and lands which were once unusually productive have been made valueless on account of the rise of the water plane. In some instances it may be necessary to drain this water off and let it waste, because it may carry a percentage of salts that would damage the land, but in the majority of cases it may be pumped from wells into canals and distributed.

Southern California presents a good example of this condition, for practically two-thirds of the water supply for this wonderfully productive area is obtained from underground sources. The water plane in a large section of this area is maintained at least 50 ft. below the surface of the ground, thus giving good drainage and constantly improving the condition of the surface soil. All of this pumped water is used for irrigation.

In all irrigation projects, whether by gravity or pumping, the first thing to be borne in mind is will it pay; that is, can the land stand the charge for the development and the cost of operation of the same. Here the question of climate and the class of products which can be raised upon the soil must be taken into consideration. In some localities a cost of $40 per acre would be a limiting price for the development. In other cases a charge of $100 per acre would not be excessive. The charge for maintenance and operation may vary from $2 to $25 or $30 per acre per annum, the nature of the crop being the

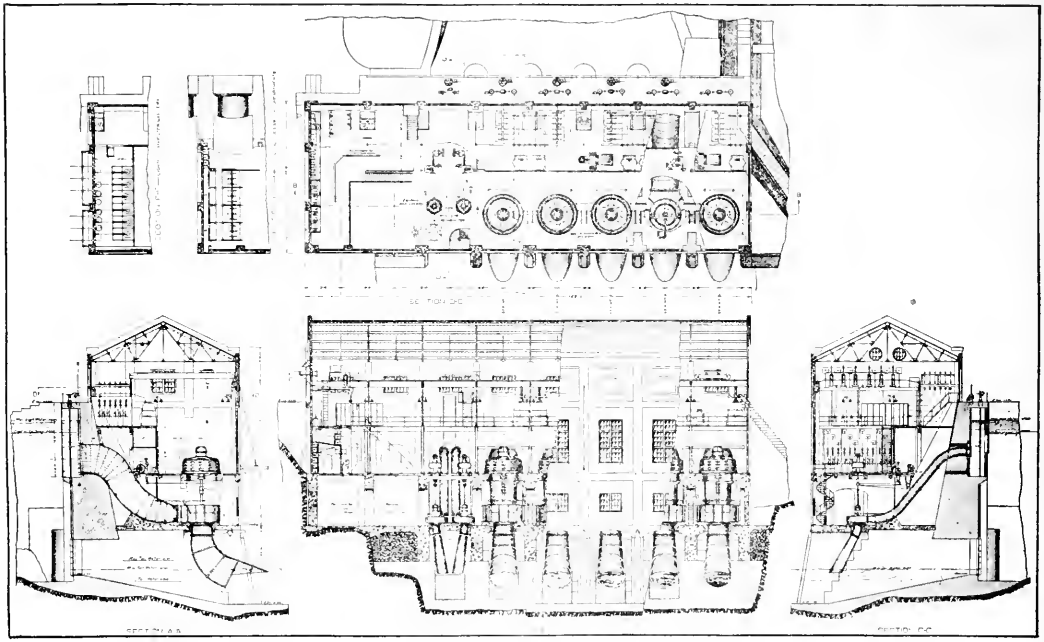


Fig. 1. General Arrangement, Minidoka Power Plant.

controlling feature. It might be mentioned that alfalfa is being grown in Southern California irrigated by water which is pumped from wells, and that orange groves are irrigated by water pumped in some cases as high as 200 ft., both with apparent financial success. On the other hand, to develop water for irrigation in the northern climes, where the season is short, and such crops as alfalfa, grain, potatoes, etc., must be depended upon, the maintenance cost per acre must be kept at a minimum.

Minidoka Project.

In the central southern part of Idaho, along the Snake River, The United States Reclamation Service has constructed what is known as the Minidoka project. This project comprises 130,000 acres of land, of which, roughly, 70,000 acres are fed by gravity system on the north side of the river, 10,000 acres by gravity on the south side of the river and the remaining 50,000 acres on the south side being supplied with water pumped from the south side gravity canal.

The Minidoka dam, designed primarily to divert water into the gravity canals, was constructed during the years 1904, 1905 and 1906. It is a rock-filled dam with concrete core, located neaer the foot of the rapids in the Snake River. It creates a fall which averages 46 ft. through the various stages of river discharge, and thus offers an excellent opportunity for development of power. In order that the water might be diverted from the main river channel during the construction of this dam, a deep sluicing channel was made through the lava formation on the north side of the river, and in this sluicing channel was constructed a concrete dam. This structure was built, so far as could then be foreseen, without complete power plant designs, so that it could later be used for he development of power. Through the base of this dam are five sluicing gates, and higher up are ten 10-ft. circular openings to be used for the power development.

In February, 1908, instructions were given to proceed with the design and construction of a plant at this point to supply power for pumping water to the high-land area 15 miles distant. This work was immediately undertaken and pushed with all possible speed. On the 8th day of May, 1909, one unit in the power plant and one unit in each of the three pumping stations were started and operated throughout the irrigation season.

The power plant equipment includes the following:

Five 1400-kilovolt-ampere, three-phase, 60-cycle, vertical alternators, each connected to a 2000-h.p. hydraulic turbine.

Two 120-kw., vertical exciter units, each direct connected to a 180-h.p. hydraulic turbine.

Five three-phase, air-blast transformers, delivering 33,000-volt current to the high-tension buses.

The general arrangement of the plant is shown in Fig. 1.

The transmission line, consisting of a single circuit of No. 3 and No. 5 B. & S. copper, carried on wooden poles, is 22 miles in length and crosses the Snake River in an 1150-ft. span of six-strand, 83,000-cir, mil copper cable at a point 11 miles below the power plant. A second similar line is being constructed on the south side of the river, using No. 5 wire, and the two lines will be connected as a loop system through the stations and to the towns on the project which are being supplied with light and power.

There are three pumping stations, each having a lift of 31 ft. (9.4 m.). No 1 contains 5 pumps, four of 125 second-feet capacity and one of 75 second-feet capacity; No. 2 four pumps, each of 125 second-feet capacity; and No. 3 three pumps, two of 125 second-feet and one of 75 second-feet capacity.

The problem in a system of this kind is to supply at as high an efficiency as practicable, taking into consideration operating conditions, first cost and maintenance, water in variable quantities with the least liability of shut-down and the least possible operating expense. Bearing this in mind, the choice of design of pumping station and especially the arrangement of the pumping units requires no small amount of study. The ordinary horizontal pump wth the necessary foot valves would have made an expensive and awkward plant, and such an arrangement would have required a much larger amount of floor space than that occupied by the vertical units which were finally decided upon. The foot valves alone would have introduced a serious loss of head by offering considerable friction, and the control of the discharge of the water by means of gate valves would have involved an expensive installation and a constant source of annoyance in operation. The idea of controlling this pump by means of a cylinder gate, similar to those used in water turbines, resulting from a careful study of the problem, was carried out with very satisfactory results. By means of this gate the flow of water in the canals is under close control by the operator in the pumping station.

The pumps are installed in separate compartments and are direct connected to synchronous motors located directly above them and supported by a heavily reinforced concrete structure. As in the case of the generators at the power house, the weight of the rotating element is carried by thrust bearings located on top of the motors. In this case, however, the bearing is of the roller type, this style of bearing having been adopted on account of the necessity of reducing friction to a minimum in starting the synchronous motors.

Motor-operated steel plate sliding gates are used to admit water from the forebay to the pump pits, two gates being provided for each pit. Provision has been made for pumping out the pits in order that the synchronous motors may be started without load other than friction and windage of the rotating parts. For this purpose an auxiliary six-inch centrifugal pump was provided and arranged so that its suction could be connected to any pit and the water entirely removed before the motor is started.

When the plant was first designed, it was thought inadvisable to adopt an arrangement by which the pumping units could be started in quick succession, on account of the danger of the sudden rush of water down the canal injuring the banks. The auxiliary pump, therefore, is of only sufficient capacity to permit starting of pumps at intervals of 20 to 30 minutes. Two years' operation has shown this to be an unnecessary precaution, and by means of a specially designed starting valve each pump is now arranged so that it can empty its own pit while the motor is running on the compensator in starting. As soon as the pit is emptied the motor approaches synchronous speed and the field is excited. This arrangement has worked out very satisfactorily, and by its use a pump can be started up and put into full operation inside of two minutes.

Each pump has but one guide bearing, a long sleeve with a stuffing box at the top, and near the top of the sleeve the bearing is supplied with a semi-hard oil having the consistency of vaseline, forced in by a special motor-driven pump for each individual bearing. Lubricating in this manner forces the lubricant downward and excludes water from the bearing and any possible grit which may be in the water. In two years' time, no rust or wear is shown on these bearings, the shaft being as bright as when it came from the factory.

The upper end of the 5½-ft. concrete force mains leading from the pumps is closed by a check valve, to prevent water from running back to the pump in case of a shut-down. This valve is made up of ¼-in. boiler plate slightly bumped, hinged from the top of the head wall and seating against rubber packing set in a cast iron ring.

The motors for driving the 125-second-foot pumps are of the self-starting synchronous type, operating at 300 r.p.m. and receiving 60-cycle, three-phase current at 2,200 volts.

The motors for operating the smaller pumps are similar except that they have a capacity of 360 h.p.

The rotors are provided with squirrel-cage windings, to permit starting as induction motors, receiving for this purpose current at low voltage from compensators. The compensator voltage is so adjusted that the starting current drawn from the line does not exceed normal full load operating current of the motor, and by careful manipulation the motor can be brought into step with the line without exceeding this. It has been found that this can be most easily accomplished by exciting the fields while the motor is running at low voltage on the compensator and then throwing over to full voltage with the machine running steadily at synchronous speed.

The step-down transformers are of the three-phase, air-blast type, receiving 30,000-volt current through oil circuit breakers from the high-tension bus and delivering the 2,200-volt current through disconnecting switches and expulsion fuses to the low-tension bus.

In pumping station No. 2 are installed the transformers necessary for station No. 3. The distance between stations 1 and 2 is 1½ miles, and between stations 2 and 3 three-quarters of a mile, the highest voltage carried to the latter station being 2,200 volts.

The exciters and blowers for the transformers are driven by induction motors and a motor-driven air compressor has been provided for cleansing the apparatus in each station. Lightning protection is provided in the form of electrolytic arresters placed inside the building.

All the switching apparatus in the pumping stations is operated by distant mechanical control. A single high-tension bus has been provided, but provision has been made by means of disconnecting switches for receiving power from either or both transmission lines.

The power house and substation buildings up to

TABLE I.

CONSTRUCTION COST OF MINIDOKA POWER AND PUMPING SYSTEM.

	Power plant	Pumping station No. 1	Pumping station No. 2	Pumping station No. 3	Trans-mission line	Total
Capacity	6,500 kw.	2,500 kw.	3,000 kw.	1,300 kw.	6,500 kw.	6,500 kw.
Building	$80,200	$34,500	$40,300	$19,200	—	$174,200
Machinery	167,699	78,800	73,600	32,500	—	352,500
Freight and hauling	25,100	11,800	10,600	6,100	—	53,600
Erection	62,300	18,200	16,800	8,600	—	105,900
Engineering and incidentals	13,600	5,600	5,300	2,800	—	27,300
Tail race	56,600	—	—	—	—	56,600
Pressure pipes	—	19,000	14,000	16,600	—	49,600
Double transmission line	—	—	—	—	35,000	35,000
Total	$405,400	$167,900	$160,600	$85,800	$35,000	$854,700
Unit cost	$63.00	$67.00	$53.00	$66.00	$5.40	$132.00

the motor and generator floor were built during the winter between the middle of November, 1908, and the first of February, 1909, and during this time the weather was very cold, reaching to as low as 15 deg. below zero. Considerable rock excavation was necessary at pumping station No. 2, and at the tail race for the power plant, and the concrete work on all of the structures had to be protected from freezing until set by means of artificial heat.

The apparatus, consisting of one unit in each station, was started in the spring of 1909 in temporary wooden structures covering the motor and generator floors; around these structures permanent buildings were finished during the summer. During the winter of 1909-1910 additional units were installed for the operating season. At the present time two additional units are being installed in the generating stations and two pumps in the pumping stations and during the winter of 1911 and 1912 three more pumps will be installed.

The following table of costs, when considered in connection with the strenuous conditions under which these plants were constructed, may be of interest. The figures given in the table do not include the cost of operators' quarters and road making. These items have been omitted, since they are so greatly dependent upon local conditions. The erection costs, however, include several items such as the cost of making preliminary tests of the hydraulic apparatus, the cost of temporary buildings for housing machinery during the time the permanent buildings were under construction and other items made necessary by the severe conditions under which the plants were constructed.

A large portion of the riveting of the turbine cases, penstocks and draft tubes was done in the field. In fact, the penstocks and draft tubes were completely assembled at the plant.

It may also be noted that the cost per kilowatt of station No. 2 is based on its transformer capacity of 3,000 kilowatts, while the unit cost at station No. 3 is based on its motor capacity.

In table II is shown the estimated operating cost, based on the actual cost of operation during the season of 1910, of that portion of the equipment then installed. There are two operators on each shift at the power house and there will be but one operator on each shift at each of the pumping stations. The cost of repairs during the season of 1910 was so ridiculously low that the figures given in the table are greatly in excess of the actual cost of repairs last year. This also applies to superintendence and general expense. Five per cent per annum depreciation has been allowed on the power installations, including buildings, and 10 per cent per annum on the transmission lines. No interest charge appears, since funds for the construction of all reclamation projects are, in reality, loaned by the United States to the settlers without interest.

The figures giving the acre-feet pumped by each station were arrived at by comparison of the installed capacity and the acre-feet pumped during the season of 1910, with the ultimate capacity of the various pumping stations and it was found that the figures thus obtained check very closely with the amount of water estimated to be necessary for the successful raising of crops on these lands; namely, three acre-feet per acre per season. The acre-feet pumped one foot high was found for each station by multiplying the total acre-feet for that station by the approximate net lift, name-

TABLE III.

FULL LOAD EFFICIENCIES.

	Efficiency	Net efficiency from water behind the dam
Turbines	81.5 per cent	81.5 per cent
Generators	96.0 "	78.2 "
Step-up transformers	98.4 "	77.0 "
Transmission line	90.0 "	69.3 "
Step-down transformer	98.0 "	67.9 "
Motors	94.0 "	63.8 "
Pumps	72.5 "	46.3 "

TABLE II

ESTIMATED MONTHLY OPERATING COSTS OF MINIDOKA PUMPING SYSTEM BASED ON ACTUAL COST DURING SEASON OF 1910 EXCLUSIVE OF DITCH TENDING.

	Power plant	Pumping station No. 1	Pumping station No. 2	Pumping station No. 3	Trans-mission line	Total
Capacity	6,500 kw.	575 sec. ft.	500 sec. ft.	325 sec. ft.	6,500 kw.	—
Labor	$700	$300	$300	$300	$100	$1,700
Supplies	150	30	30	15	5	230
Repairs	75	20	20	10	10	135
Superintendence and general expense	400	200	200	150	40	990
Depreciation	1,460	670	670	350	300	3,450
Total	$2,785	$1,220	$1,220	$825	$455	$6,505
Acre feet pumped	—	25,000	20,000	15,000	—	—
Acre feet pumped 1 ft. high	—	750,000	600,000	450,000	—	1,800,000
Kw-hr	3,600,000	1,500,000	1,200,000	900,000	—	3,600,000
Cost per acre ft. 1 ft. high	0.154 ct.	0.163 ct.	0.203 ct.	0.183 ct.	—	0.362 ct.
Cost per kw-hr	0.077 ct.	—	—	—	—	0.18 ct.
Cost per acre per season	—	—	—	—	—	78 ct.

Depreciation at 5 per cent per annum on complete power installation, 10 per cent on line.
Estimates for the six months of the irrigating season assuming that the winter operating expenses are covered by the sale of power.
Allows three acre-feet per acre during season over 50,000 acres.
Average lift 73 feet.

ly, 30 ft. The results of last season's run showed that the kilowatt-hours generated at the power plant were almost exactly double the acre-feet pumped one foot high by the pumping stations; and since one kilowatt-hour is equal to 1.01 acre-feet one foot high, this would indicate a working efficiency from power plant to water delivered in the upper canals of approximately 50 per cent. This actual working efficiency should be compared with the following table of full load efficiencies, starting with the water behind the dam and working through the system to the water delivered in the upper canals. The cost of operation per acre-foot pumped one foot high given for the various pumping stations might be taken to represent what a company would expect to pay for operating expenses, exclusive of the cost of power in a pumping station of this character.

In the table of operating cost it has been estimated that the entire winter operating expenses, including fixed charges, will be covered by the sale of power and that the land under the pumping season will not be charged with any standby expenses for the winter season. In such a system as this, where a large amount of power is required during the summer irrigating season, and none during the winter season, the development of a winter load is very desirable, and with this in view, the transmission lines have been extended to the towns of the Minidoka Project and power is these sold for commercial purposes. Extremely low rates are offered for electric heating and the use of large amounts of power for all purposes during the winter is encouraged in every possible way. By furnishing power at very low rates, especially during the winter months, the annual operating and maintenance charges against the pumping system are reduced and the settlers on the project, who have paid for this work, have the benefit of cheap light, power and electric heat.

THE VOLTAGE REGULATOR AT NORTH TOWER.

BY GEO. H. BRAGG.[1]

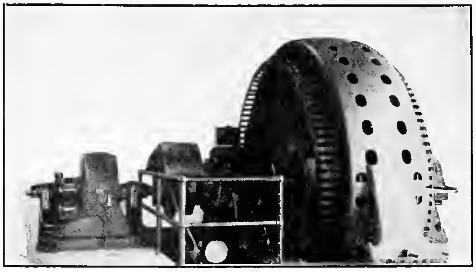
In every system of electrical distribution there is a loss of energy and consequently a loss of voltage. The voltage delivered by the power house to the lines decreases in value as the distance becomes greater, depending in amount upon the size of conductors and load.

The commercial effect of this voltage loss is "poor light," or inoperative induction apparatus, and unless some means is employed to overcome it, the quality of the service is "poor."

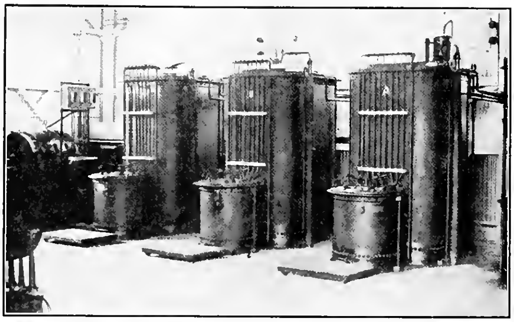
Four types of voltage regulators or compensators are on the market today, each adapted to a particular kind of work. Without going into a description of them, they are as follows: The induction type, the step-by-step or dial switch type, the relay type, and the synchronous type.

The first and second are used principally on the substation feeders, the third at the power house on the generators, although they are sometimes used in the substation on synchronous apparatus, and the fourth on long-distance transmission systems.

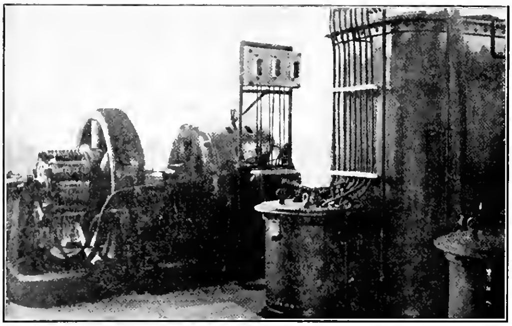
[1]Operation and Maintenance Department, Pacific Gas and Electric Company.



Synchronous Regulator.



Motor-Generator Exciter Set.



Main Transformers.

The regulator at North Tower is of the latter type. In every respect it is like the revolving-field generators at the power houses. Its nameplate reads as follows: "S. K. C. System. Revolving Field Alternator. Serial No. 1235—Type 144—4400 K. W. Three-phase, 60-cycle, 11,000 volts, speed 300 r.p.m."

A brief description of the auxiliary apparatus comprising the complete installation will serve to explain the illustrations and at the same time assist in a better understanding of the operation of the regulators. The 110-kw. motor-generator set serves the double purpose of exciting the regulator and furnishing power to its starting motor. It is driven by a 2200-volt motor supplied by a bank of 35-kw. transformers, which steps down the station voltage from 11,000 to 2200 for the motor. The 100-h.p. direct-current starting motor is geared to the shaft of the regulator, and it receives its power from the motor-generator set, as above stated.

In order to place the regulator in operation on the transmission system the 100-h.p. motor is furnished with power, and gradually the speed of the regulator is increased from rest up to 300 revolutions per minute. At the proper instant the main switch is closed and the regulator then continues to operate in synchronism at the constant speed of 300 revolutions per minute, receiving the power to drive it from the lines. There is no further use of the starting motor; therefore, it is disconnected from the regulator and shut down.

It may be of interest to describe here the mechanical connection between the starting motor and the regulator. Bolted to the shaft of the regulator there is a large gear which meshes with a pinion on the shaft of the starting motor. This pinion is capable of being moved parallel with the axis of the starting motor shaft, the key and shaft being approximately double the width of the pinion. When the motor has performed its work, a lever is thrown over, and the pinion is moved on its shaft until it is out of mesh, then by opening the switch the starting motor will come to rest. The regulator is now capable of regulating the line voltage; by turning the hand wheel on the rheostat in its field, the current in its armature will vary. A point can be found where the current will be at a minimum, and a turn of the hand wheel in either direction will cause the current to increase. Graphically this is shown in Fig. 1.

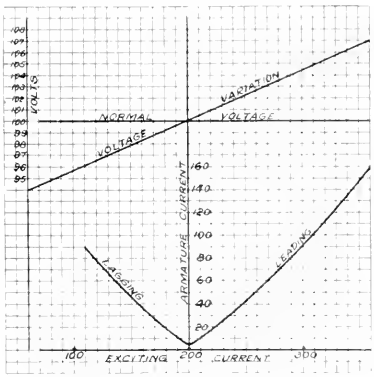


Fig. 1.

Increasing the exciting current from the minimum armature current condition causes the regulator to draw a leading current, which in turn causes the voltage to raise. Likewise, decreasing the exciting current from the minimum armature, current condition causes the regulator to draw a lagging current, and this current causes the voltage to lower. The straight line at the top gives an idea of about the range of the regulator. It shows a regulation of approximately ten per cent, and for all variations within this range the line voltage can be held constant. To make the regulation automatic the rheostat of the regulator is equipped with a motor as shown in Fig. 2.

The motor is operated by a relay switch which in turn is operated by a contact making voltmeter. The wiring of this apparatus is shown in Fig. 3.

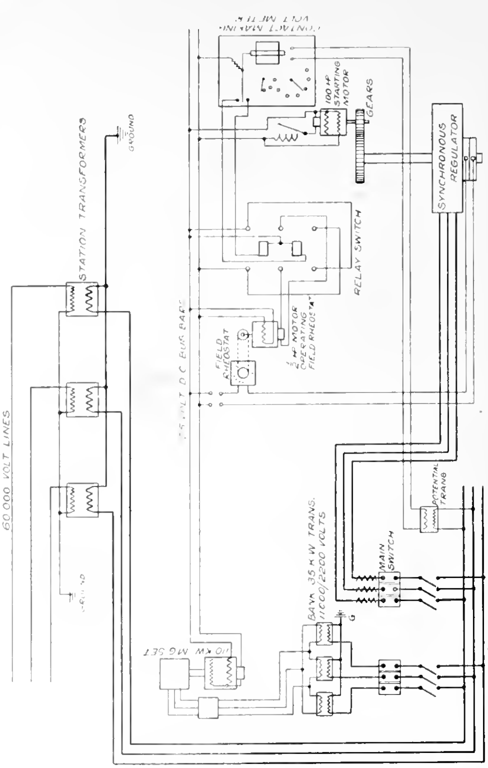


Fig. 3.

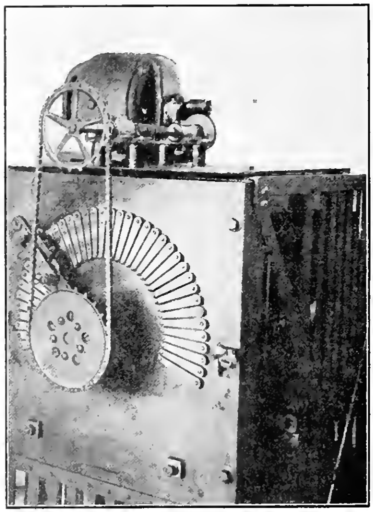


Fig. 2—Voltage Regulator.

A change in the line voltage from the predetermined value causes the contact making relay to move up or down. This movement operates the relay switch, which in turn operates the motor on the rheostat.

ENTROPY.

BY ALEXANDER MCADIE.

Many of us read with interest the discussion on "The Physical Meaning of Entropy," in the Journal of Electricity, Power and Gas, Dec. 3, 1910, and succeeding issues. Mr. A. L. Menzin's papers brought home to most of us the fact that aside from the mathematical concept of entropy as set forth in the Clausius integral $\int \frac{dQ}{T}$ there was and should be a physical significance which treatises in thermodynamics fail to convey to students.

The discussion between Mr. Menzin and Professor Durand was in my opinion one of the most valuable and enlightening contributions to the subject that has yet appeared and should be given wide publicity. Students of thermodynamics, especially young men in the universities, will do well to obtain copies of the Journal of the dates mentioned for future reference.

Waste of heat accompanies every practical attempt to obtain work from heat. To the engineer it is all important to have clear conceptions of heat, energy, waste of heat and the process and agency through which transformation into motive power is accomplished.

Mr. Menzin defines entropy as a property of matter which determines the least amount of heat which must be rejected to an external substance during any change of thermal state. It is then the least amount of heat which must be rejected for each and every degree of the absolute temperature at rejection. Professor Durand while not questioning the method employed by Mr. Menzin, whereby the rejection of heat or the change of entropy backward is made to equal the change forward, insists that this does not aid in getting a clear idea of the change of entropy for a simple heating and cooling process. He holds that it would be well if all engineers would realize once and for all

> "That from the nature of things such attempts (to give a physical conception to entropy) must be futile and such effort will only result in a labored and backhanded physical concept which will be of small value either to physicists or engineers."

The writer is not an engineer; but only a meteorologist who while looking at the clouds from day to day, cannot fail to wonder at the processes at work in the expansion and condensation of the water vapor. He wishes he were an engineer, for to him the clouds represent thermal engines and he longs for the time when they will be so studied and classified rather than as now, according to appearances. In considering warm and cold cloud masses rising and falling and going throught various cycles, entropy will be a factor of importance. It is therefore necessary at the outset to have a clear conception of the term "entropy" not merely as a mathematical abstraction but as a physical condition of heat transfer.

There has just come into his hands an address delivered to the Physical Society of London, Feb. 10, 1911, by Professor H. L. Callendar, which contains a discussion of the caloric theory of heat as developed by Carnot in his famous essay on the motive power of heat (Paris, 1824). From it the writer gains a clearer conception of entropy and desires to give others the same opportunity. Few men are better qualified than Professor Callendar who has spent many years in both experimenting and teaching. The relations between energy and heat, especially in reversible processes, are more clearly expressed, Callender thinks, by the use of Carnot's conception of caloric than by the present kinetic theory. "It emphasizes the differences," he says, "between reversible and irreversible transformations and directly provides the natural measure of a quantity of heat as distinct from a quantity of thermal energy."

In the Carnot equation $W/G = F\ (t)$ or $dw/dt = QF'\ (t)$ the Carnot function $F'\ (t)$ must be the same for all substances and hence the efficiency is independent of the agency used; but is a function of the temperature limits only. In a gas expanding from V_o to V,

$$Q = R \log_e \left(\frac{V}{V_o}\right) F^1 t$$

and the difference of the specific heats at constant pressure and volume given by $S_p - S_v = \frac{R}{T\ F\ (t)}$ is independent of the pressure and is the same for all equal volumes of all gases. Thus heat is measured as caloric and temperature is measured on the scale of a gas obeying the law $pv = RT$ and S_v independent of pressure. If W be the work produced from a quantity of caloric Q at temperature T then $W = AQ\ (T - T_o)$ which is the correct, final solution of the problem.

According to Carnot's theory it can be assumed that the motive power of the caloric generated at any temperature, namely, AQT, should be equal to the motive power consumed in friction. The absolute unit of caloric, which may be appropriately called the Carnot, is that quantity which is capable of doing one joule of work per degree fall. The mechanical equivalent of Q Carnots at T Absolute is QT joules.

From Carnot's data the work done in a cycle per gram of steam vaporized at 100 degrees C. per degree fall, is 0.611 kilogrammeters, or nearly 6 joules. The caloric of vaporization is 6 Carnots. Similiarly from Kelvin's data for the pressure required to lower the freezing point 1 degree C. the caloric of fusion of ice is 1.2 Carnots.

Callendar refers to a proposed experiment where steam at 100 degrees C. is condensed on one side of a conducting partition, while ice is melted at 0 degrees C. on the other. The caloric falls irreversibly by conduction. For each gram of steam condensed or for each 6 Carnots supplied at 100 degrees C., 540/79.5 grams of ice would be melted. Six Carnots at 100 degrees C. allowed to fall directly to 0 degrees C. by conduction produce $\frac{540 \times 1.2}{79.5}$ or 8.17 Carnots at 0 degrees C. The quantity of caloric at 0 degrees C. is greater than that supplied at 100 degrees C. in the proportion of 8.17 to 6, which is nearly the same as the ratio 373/273 of the absolute temperatures. The motive power of the caloric at 100 degrees C. or 6x373 = 2,238 joules is the same as the motive power of the caloric found at 0 degrees C., namely, 8.17x273. = 2,231 joules. Professor Callendar points out that since a quantity

of heat is most directly measured as a quantity of thermal energy, we have unconsciously gotten the idea that heat is energy and that a quantity of heat is completely specified by its energy equivalent.

He says,

"The absurdity would be at once apparent, to take an analogous case, if we were to measure a quantity of electricity always in kilowatt-hours. The equivalent energy determines the cost of production and is for many purposes the appropriate and sufficient measure, but we should fare very badly in electrical theory without the separate units of quantity in ampere-hours and pressure in volts."

Caloric then is the "thermodynamic function" of Rankine and the "equivalence value of a transformation" of Clausius, who in 1865 finally gave it the name entropy and defined it as the integral of dQ/T, or as Callendar points out, much better defined as A in the equation $W = AQ\ (T-T_0)$.

Callendar concludes with the statement that the conduction of caloric is closely associated with the electrons and that the science of heat would gain by attaching a more material conception to the true measure of a quantity of heat as distinguished from a quantity of thermal energy.

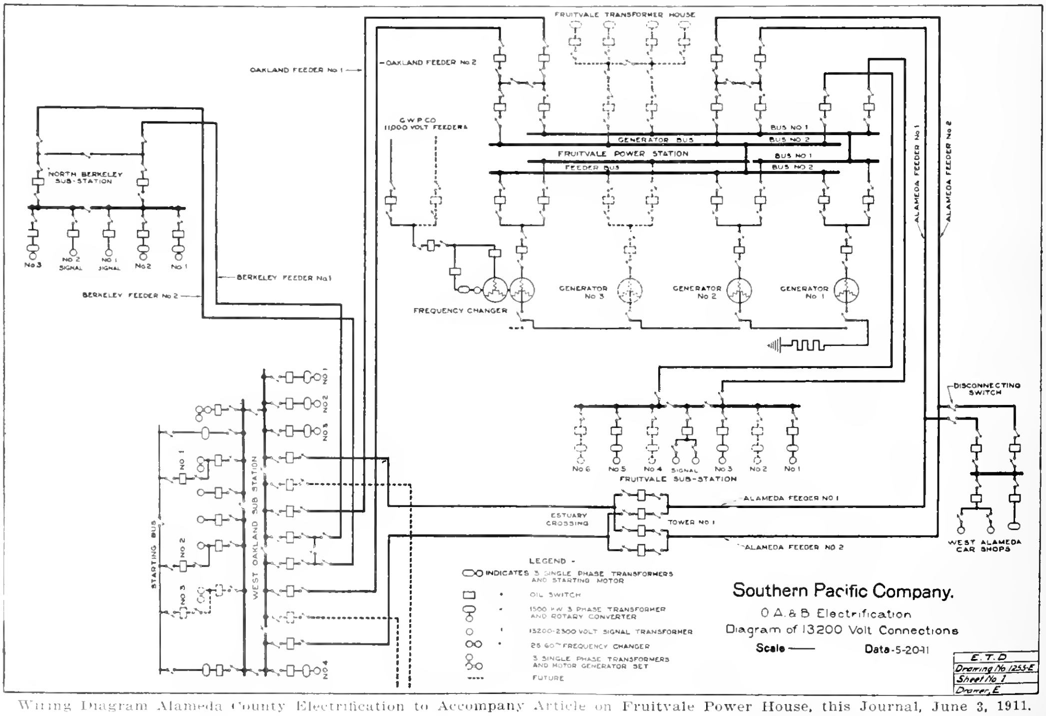
In conclusion the writer wishes to urge the general adoption of the absolute scale of temperature, whether based on the absolute zero of the gas thermometer or the absolute zero of heat according to Kelvin. He believes that the use of this scale and the disuse of both Fahrenheit and centigrade scales will assist greatly in the forming of clearer conceptions of heat quantities and processes. While urging engineers to use the one proper temperature scale, he is not unaware of the fact that it is also incumbent upon meteorologists and physicists to set the example by using proper scales and units. In this connection he refers to a paper upon "New Units in Aero-Physics" published in the American Journal of Science, October, 1910.

WHERE LIGHTNING STRIKES.

It is shown that 362 out of each million buildings in Schleswig-Holstein, which has an area of about 7,200 square miles, are annually struck by lightning. The number of buildings struck in the open country is nearly double that struck in the towns. The strokes were much more frequent and the damage was two and one-half times as great with buildings with thatched or wooden roofs as with slate or metal roofs. The greatest damage occurred on the average during the last third of July, the greatest number of electric storms occurring during that period. The greatest number of electric discharges was observed between 4 and 5 o'clock in the afternoon.

All kinds of trees were struck, but certain kinds more frequently than others, depending upon the character of the bark and wood, which in some cases furnish a poorer conductor and thus afford greater protection than others. Poplars were most frequently struck. Of 239 trees struck in 15 years, 109 were poplars, 26 oaks, 3 linden, 21 ash, 11 fruit, 10 willow, 10 pine, 6 alder, 3 elm, 1 birch, and 1 beech.

It was observed that strokes were two and one-half times more frequent in marshy than in dry sections, and that the frequency of strokes decreased with forest growth and increased with its removal.



Wiring Diagram Alameda County Electrification to Accompany Article on Fruitvale Power House, this Journal, June 3, 1911.

THE NEW YORK-DENVER TELEPHONE CIRCUIT.[1]

BY B. GHERARDI.

The New York-Denver circuit has a length of a little over 2,000 miles, that is, it is more than twice as long as the New York-Chicago circuits, which are about 950 miles long, and is a little less than twice as long as the New York-St. Louis circuits, which are about 1,050 miles long. Until the completion of the developments which have made the New York-Denver circuit possible, the New York-Chicago and New York-St. Louis circuits represented practically the limits of long distance transmission. Now service from New York to Denver can be given which is as good as, or even better than, the service given a year or two ago from New York to St. Louis or Chicago, and this without using any heavier wire than was formerly employed. All our old circuits from New York to Chicago and St. Louis were No. 8 B. W. G. wire, weighing 435 pounds to the mile. No heavier wire is used to get the New York-Denver service.

One of the aims of Mr. Vail is to give universal service. The first step in the direction of giving such service is obviously to be able to give transcontinental service—that is, a talk from New York to San Francisco. Diagram I will show how much of a step in this direction has been made since Mr. Vail's wish on this matter was stated about two years ago. This diagram shows what we could do two years ago, what we can do now, and how much remains to be done to get to San Francisco. It was a long step from Chicago to Denver. One more step a little longer will take us to San Francisco.

Diagram I.

Two years ago we did not know how to successfully load No. 8 circuits; how to commercially phantom No. 8 circuits, or how to combine phantoming and loading. Since that time we have found out how to do all of these things, and it is as a result of these developments that the Denver circuit is a reality today.

Before explaining how each one of these results was accomplished, and the part which each result contributed to the achievement of talking from New York to Denver, I will describe the circuit. Diagram 2 shows in a general way the New York-Denver circuit. From New York to Morrell Park (the test station just outside of Chicago), there are two loaded No. 8 circuits. These are phantomed, thus creating a third circuit and this phantom is also loaded. From Morrell Park to Omaha there is a loaded No. 8 circuit. No loaded phantom has as yet been provided here because the pole line did not carry two No. 8 circuits so located with relation to each other that they could be phantomed. Arrangements are being made to move a No. 8 circuit on this line to pins adjacent to the present loaded No. 8 circuit and as soon as this is done a phantom will be created from the two circuits and this phantom will also be loaded, thus giving between Chicago and Omaha the same arrangement as now already exists between New York and Chicago. From Omaha to Denver there are two No. 8 circuits which have been phantomed, thus creating a third circuit, and the two physical circuits and the phantomed circuit are all loaded, thus giving from Omaha to Denver the same general circuit equipment as now exists between New York and Morrell Park.

The circuit from New York to Denver, utilizing the phantoms where they exist and including the reflection losses due to the present irregular arrangement, is equivalent in transmission efficiency to about 30 miles of standard cable. The circuit if connected throughout on a non-phantomed physical circuit over the same route is equivalent to about 32 miles of standard cable. When the final arrangement is completed btween Chicago and Omaha our present estimate is that a New York-Denver connection on the phantom will be equivalent to between 28 and 29 miles of standard cable. If the circuit were made up throughout of unloaded No. 8's it would be equivalent to 69 miles of standard cable. A No. 8 unloaded circuit from New York to Chicago by the shortest route is equivalent to about 34 miles of standard cable from test board to test board. It will thus be seen that the new circuits to Denver are better than our old circuits were to Chicago. Not only are they better, but they are cheaper because with the art as it was two years ago with four No. 8 wires we could get two circuits; now with four No. 8 wires and some coils and insulators we get three circuits of more than double the transmission efficiency. It is interesting to consider what results these cheaper circuits will accomplish when used in connection with the Chicago business. The No. 8 unloaded circuit to Chicago has a transmission efficiency of 34 miles. By the use of telephone relays or repeaters this can be cut down to about 22 or 24 miles. The efficiency of the No. 8

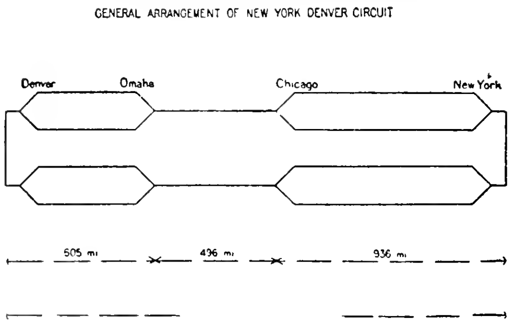


Diagram 2.

[1]Abstract of paper read before New York Telephone Society.

loaded circuits from New York to Chicago is equivalent to about 17 miles of standard cable. The efficiency of the loaded phantom is equivalent to about 15 miles of standard cable. As soon as certain additional circuits via Pittsburg are loaded and phantomed, we shall start using the high-grade circuits for New York-Chicago business.

As I have already stated, there are embodied in the New York-Denver circuit three advances recently made in the art, namely

Loading No. 8 circuits.

Phantoming No. 8 circuits, and combining loading and phantoming on the same circuits.

The problem of loading No. 8 circuits was primarily a problem in connection with the insulation of the line wires. A No. 8 circuit can be loaded with the same coils used on No. 12 circuits and these coils would be spaced in the same manner, that is, at 8-mile intervals. It has been a fact known to us ever since we started to do commercial loading that low insulation on a loaded circuit has a much greater effect in impairing the efficiency of such a circuit than the same insulation has on an unloaded circuit. It has also been known that the effect of low insulation on the No. 8 circuits was much more serious than on the No. 12 circuits.

When we first began to load our open wire circuits about ten years ago it was found that the No. 12 gauge circuits which had been loaded gave satisfactory results in dry weather. In wet weather the results were not so good, due to the lower insulation at such times, but these results were good enough. In the case of No. 8 circuits, however, it was found that when they were loaded the effect of low insulation was so serious in wet weather that at such times the circuit was no better than if it was unloaded—sometimes even worse. A system of loaded No. 8 circuits could not, therefore, be considered satisfactory, as it would be a system which part of the time would be better than if not loaded and part of the time worse.

It having been established that a substantial improvement would have to be made in the insulation of No. 8 circuits in order that they might be successfully loaded, and reasonably uniform results obtained from the loading, a study of line insulation conditions was made to determine what steps would be necessary in order to improve the line insulation. Aside from the general insulator leakage two particularly weak points were found in the insulation of open wire circuits. One of these was at transposition points. Diagram 3 shows the arangement of the wires on a standard single pin transposition. It will be seen that with this arrangement there is a very direct leakage path from one wire to the other during wet weather. The part of the insulator surface protected by the petticoat is the only part that is of much value during wet weather. Actual measurements showed that the leakage on lines equipped with standard single pin type transposition insulators was 20 per cent greater during wet weather than on lines where the two wires were never allowed to be on the same pin. Of course the old standard transposition which employed two insulators, both of the transposition type, and in which the wires were tied to both of them, was just twice as bad as the single pin transposition already discussed. The method of overcoming this difficulty was to transpose the wires without bringing them onto the same insulator. This is accomplished in the manner shown in the second part of Diagrom 3, that is, to employ the phantom transposition bracket for transposing a physical circuit. The same problem, of course, arises when phantoms are involved and having used the phantom bracket for the transportation of physical circuits, something else is required when phantoms are involved. This arrangement is also

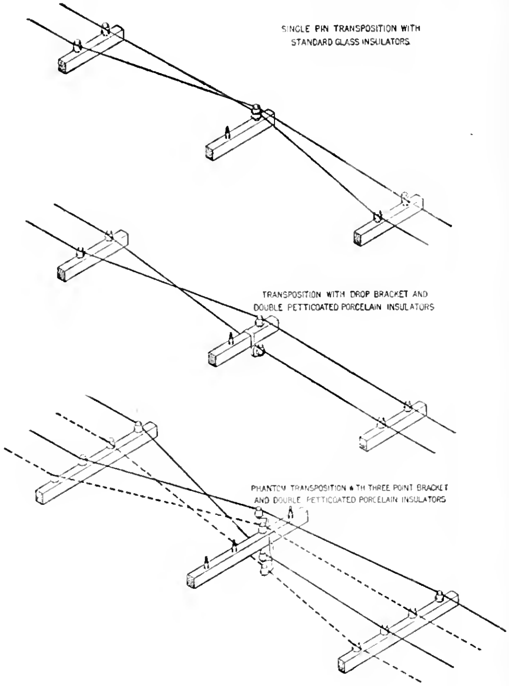


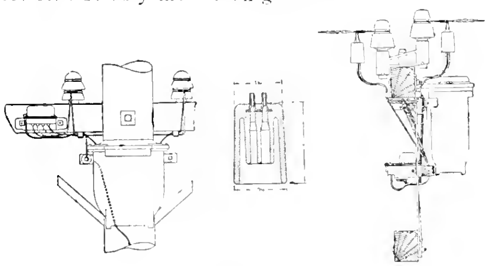
Diagram 3.

shown in the diagram. By the means described above the transposition as a factor in producing low insulation is eliminated and the transposition points are made just as good as any other point in the line.

Another point at which it was found that there was considerable leakage was where, for the purpose of inserting loading coils, connecting with a test station, or for any other reason, the wires were bridled. These places were particularly bad during wet weather, especially after the bridle wire had been in service for a short time and had weathered. The path of this leakage is shown in part 1 of Diagram 4. The braid on the bridle wire soon becomes weathered and when wet is a fair conductor. Leakage takes place easily over the wet surface at the end of the rubber insulation and thence to the wet braid. This difficulty was overcome by a very neat device known as a bridle wire insulator. Part 2 of the diagram shows a picture of such a bridle wire insulator, and part 3 shows a cross section of it. The two wires shown

in connection with this bridle wire insulator extend—one to the loading coil and the other to the lightning arrester. The adoption of this arrangement has completely eliminated low insulation at bridling points.

In addition to the changes at transposition points and at bridling points referred to above, it was thought desirable on the first of these loaded No. 8 circuits to use a line insulator that would be more efficient than our standard glass insulator. After a careful study of insulator design and insulator materials, it was decided to try on these circuits a double petticoated porcelain insulator. Tests on these insulators extending over a period of several years have shown that the new insulator is several times as good in wet weather as the standard insulator. Part of this improvement is due to the design of the insulator. Some is attributed to the use of porcelain. An objection to these insulators is that they are not so easy to manufacture uniformly, and that each insulator must be inspected, whereas with glass insulators they may be inspected by sample. These porcelain insulators also cost considerably more than glass insulators.


Part 1. Part 2. Part 3.
Diagram 4.

As a result of applying the improvements described above to our No. 8 circuits, it has been found by measurements and tests extending over a long period that the line insulation was at all times sufficiently good to warrant the loading of No. 8 circuits.

Phantoming No. 8 Circuits.

The problem of the phantoming of No. 8 circuits is one in phantom repeating coil design. To meet the special conditions existing in connection with the phantoming of loaded No. 8 circuits as used in our plant, it was desirable that apparatus should be developed of the highest possible transmission efficiency. In order to do this the ringing efficiency of the phantom coil was sacrificed and special means for ringing through these coils had to be adopted. In this way and by specially designing a coil to meet the circumstances of these circuits, coils that were suitable were developed. The manner in which these coils are used in phantoming a circuit is shown in Diagram 5.

Up to very recently, while we knew how to phantom ordinary circuits, it was impracticable to phantom loaded circuits because the loading coils so unbalanced the phantom and so increased its effective resistance that a phantom circuit created out of loaded circuits could neither be made quiet nor made efficient from a transmission standpoint. This problem is one of loading coil design. Such coils were devised and are now in successful use on the New York-Denver circuit.

The phantom produced in this manner is, however, not loaded. It is, of course, desirable to load the phantom in order to obtain the benefits of improved transmission on this circuit also. To do this another coil was devised, the windings of which were so arranged that they would introduce inductance in the phantom circuit without affecting the side circuits.

An important piece of work which it was necessary to carry on in parallel with the work dealing with the wire plant, was the development on a satisfactory cord circuit to be used with these very efficient loaded lines. Very successful results have been obtained in this direction, and a cord circuit has been devised on which the transmission losses are almost negligible. With the new cord circuits the loss brought in on the New York-Denver circuit by the two terminal cords at the toll switchboards at New York and Denver and the two intermediate cords at Morrell Park and Omaha

USE OF PHANTOM REPEATING COILS

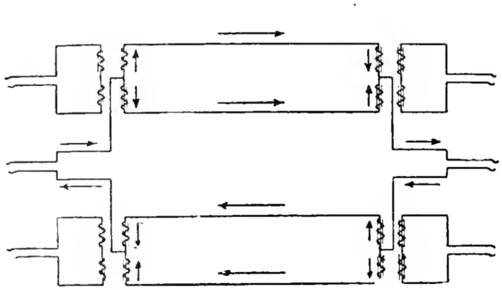


Diagram 5.

is only 0.3 miles of cable. With the old type of cord circuit these losses were substantially greater. The losses with the old cord circuits were equivalent to making the line from New York to Denver 300 miles longer than with the present arrangement.

While the foregoing touches upon the engineering work necessary to successfully construct a circuit which would operate from New York to Denver, another series of problems arose from the fact that we have not now and could not for many years expect to have traffic sufficient to justify three or even one through circuit from New York to Denver. Plans were worked out by which at certain points one or both of the physical circuits could be cut and made available for way connections without interfering with the use of the phantom on a through connection. Such arrangements are used at several points along the circuit. At other points the physical circuits, and also the phantom, are terminated and are available for connection to any other circuits in the usual manner.

Each of the various functions which we have caused these four wires to perform by the arrangements described above have been obtained in such a manner that no one of them substantially interferes with the others. The maintenance, however, of the circuits—particularly of the phantom—is not an easy proposition, and requires considerable skill on the part of those responsible for it.

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
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CONTENTS

Electrical Accidents

Garbled press accounts of several distressing electrical accidents are causing much unjust criticism of the power companies. Electricity is mysterious enough without ascribing to it properties which exist only in the disordered brain of a reporter inexcusably ignorant of the fundamental characteristics of commercial electrical phenomena. Whether governed by accident or by intention, an electric current obeys fixed mathematical laws whose conditions are followed in the design of electrical systems built for maximum efficiency, which means the least possibility of disaster.

Every man who has any business around a power system or where he can touch live wires knows, or ought to know, that if he places his body either directly or in metallic connection between two points where there is a difference of potential, a current will flow between these points. According to Ohm's law if the difference of potential is sufficient and the resistance of the body (which varies somewhat, depending upon the length of the path traversed and the nature and condition of the contacts) low enough to allow about one-half an ampere to pass through a vital part, the result will generally be fatal. If the current flow is the result of an extreme potential difference, such as a direct ground connection from a 60,000-volt circuit, a much larger current than that which is necessarily fatal may flow and it is those currents of high density which cause the severe burns often accompanying these accidents. Many freak accidents are recorded where the victim has been fearfully burned and yet has survived. These are in no way due to electrical peculiarities, but to the means of contact or other extraneous conditions. For instance, examples have been known where the victim, while perspiring freely, has formed a conductor for a short-circuit in which the entire current passed over the body surface, which offered a much lower resistance to the passage of the current than the skin at the points of contact.

To so cover all live circuits that human contact could not be made, even if intentionally attempted, would be impracticable, and to provide for all unforeseen accidents would be impossible. As a matter of record, accidents of this sort have invariably occurred through events so unusual or unforeseen, that blame could not be attached to the operating company and in most cases the probability of repetition would be most remote. On the other hand the contributory cause is generally carelessness or thoughtlessness on the part of the victim.

It is slight satisfaction to one who may survive or to the loved ones who may be left behind, that a momentary abberation of attention has earned such a punishment. These attributes are a manifestation of the undeveloped part of human nature. Here then is where the improvement must be made. We have learned not to place our head in a furnace to observe the fire or to stand on the track before an approaching train, and we must remember that, live or dead, electrical circuits appear the same, it is foolhardy to take any chance; if the body by contact forms a path of least resistance between points having potential difference a current will flow.

PERSONALS.

A. H. Woodbine, an engineer of Los Angeles, is at San Francisco.

C. N. Black, general manager of the United Railroads of San Francisco, is visiting New York and other Eastern cities.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast branch office, is making a trip to the firm's New York office.

S. L. Stovall, assistant to John Coffee Hays, general manager of the Mt. Whitney Power Company of Visalia, is at San Francisco.

J. P. Poindexter, manager of the Pacific Gas & Electric Company's system at Marysville, was at San Francisco during the past week.

J. G. Anderton, manager of the Sierra & San Francisco Power Company's Tuolumne division, has returned to Sonora from San Francisco.

Wynn Meredith, manager of Sanderson & Porter's Pacific Coast branch, has just returned to his San Francisco office from British Columbia.

E. V. D. Johnson, general manager of the Northern California Power Company, with headquarters at Redding, was at San Francisco this week.

C. E. Grosbeck, one of the vice-presidents of H. M. Byllesby & Co., who recently returned from a trip to the Hawaiian Islands, is at Portland, Ore.

T. E. Bibbins, assistant manager of the General Electric Company's San Francisco office, has returned to San Francisco after visiting the factory at Schenectady, N. Y.

W. L. W. Curl, the California State Secretary of the National Association of Stationarry Engineers, attended the convention of the organization at San Francisco during the past week.

L. H. Baldwin, with the Pacific Coast branch office of the Kellogg Switchboard & Supply Company, has returned to San Francisco, after a trip through Northern California and Southern Oregon.

J. W. White of the San Francisco office of the Fort Wayne Electric Works, is making an extensive tour of the Nevada and Northern California mining camps, in the interests of electric rock drills and other apparatus.

F. F. Barbour assistant to the president of the Pacific Gas & Electric Company, has just returned to San Francisco from an extended tour of Central and Northern California, where the corporation has numerous electric power plants.

Thomas Mirk, of Hunt, Mirk & Co., spent the past week at San Diego, in connection with the work of remodeling and increasing the capacity of the San Diego Electric Railway Company's power plant, which is progressing rapidly.

Harry Leavitt, a popular engineer, who was for a number of years on Atlantic steamers and more recently in charge of power plants in the Fairmont Hotel and elsewhere, has succeeded Chief Engineer Richards in the Monadnock Building, San Francisco.

F. C. Barrington has resigned as president and manager of the Columbian Electric Company of St. Joseph, Missouri, to become manager of the lighting department of the St. Joseph Railway, Light & Power Company. His holdings have been taken over by W. R. Thomas, his business partner.

John R. Freeman, a consulting engineer of New York, is on his way to San Francisco to assist in tabulating the data on the value of the Spring Valley Water Company's properties for the Board of Public Works. The company's latest selling price is said to be about $41,000,000.

N. A. S. E. CONVENTION.

The eighth annual California State convention of the National Association of Stationary Engineers opened at San Francisco Tuesday June 6th. Forty-four delegates had been elected and there was thus a full representation of the 900 engineers composing the six associations in the State of California.

The following resolution was adopted at the opening on June 6th: "Resolved, that the eighth annual California State Association in convention assembled, that members of this association shall remain absolutely neutral in any controversy between employers of engineers and engineers themselves."

On Tuesday night a theatre party at the Orpheum was attended by a large party of delegates and their ladies.

On Wednesday a business session was held at the Merchants' Exchange building at 3 p. m. A sight-seeing automobile ride was given to the ladies at 10 a. m. and luncheon at Union Square Hotel upon return.

On Thursday night a dinner party was given at the Union Square Hotel.

On Friday morning a trip was taken about the bay on the U. S. steamer General Mifflin.

David Brian of Los Angeles was elected president for the ensuing year, succeeding Herman Nothig.

State Secretary W. T. W. Curl says that the Los Angeles association has 444 members, with prospects of rapid growth, making it the second in numbers in the United States. Chicago No. 1 is the largest, with over 500 members, and San Francisco has a total of 350 members in its two associations. There is no doubt that Oakland and Sacramento will both form associations soon after this convention.

TRADE NOTES.

The name of the "Pacific Miner" of San Francisco has been changed to "The Mining and Metallurgical Journal."

An order for two 1000-kw. synchronous motor-generator sets was recently received by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., from the San Francisco Gas & Electric Company, of San Francisco, Cal.

The "California Derrick" of May 25, 1911, contains a valuable article by Paul W. Prutzman on "A Continuous Topping Plant," this being one of a long series of a discussion of the problems of oil refining by Mr. Prutzman and Professor Edmund O'Neil.

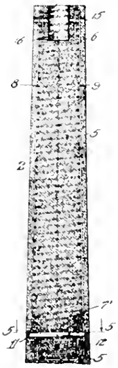
The Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., recently received from the Seattle-Everett Traction Company, Bellingham, Wash., an order which calls for a quadruple equipment of No. 304 railway motors with the new HL (Non-Automatic) Unit Switch Control.

ELECTRICAL CONTRACTORS MEETING.

The electrical contractors of California are busy preparing for their State Convention, which takes place at Santa Catalina Island in July. A special rate good for thirty days has been obtained for the contractors and their friends. The contractors will be entertained by the Los Angeles contractors and will go into camp at the Island with quite a large body. There being in the California State Association of Electrical Contractors about 200 members, coming from San Francisco, San Jose, Sacramento, Stockton, Eureka, Oakland, Los Angeles, Palo Alto, Bakersfield, Fresno, Santa Barbara, Los Aangeles, Palo Alto, Bakersfield, Fresno, Santa Rosa and San Rafael. All members of the building crafts are invited to take advantage of the excursion; information can be obtained from officers. The officers are W. S. Hanbridge, San Francisco District; H. B. Woodill of Los Angeles, first president; F. V. Meyers, secretary; L. R. Boyton director for vice president; Carl Heilbron of San Diego, second vice president; John Rendler of Los Angeles, director for Los Angeles district and in charge of the entertainment.

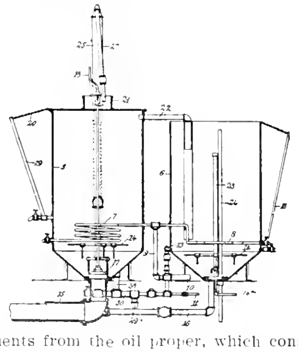
PATENTS

993,427. Reinforced-Concrete Pole. Edward L. Williams, Igerna, Cal. A reinforced concrete pole comprising a plurality of sections, each section being composed of reinforced concrete and provided with an integral socket at one end and an integral concrete plug at the other end, a reinforcing ele-



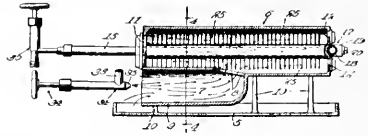
ment disposed longitudinally of the section and extending into said plug at one end and into the walls of the socket at the other end and looped back upon itself in said plug and in the walls of said socket, and means disposed through the integral plugs and sockets to lock the sections together to form an integral structure, substantially as described.

994,100. Process of Breaking up and Separating the Gaseous Liquid and Solid Constituents of Crude Petroleum. Linus W. Brown, Monrovia, Cal.: George Francis Brown and Daisy Lucretia Brown Condon, executors of said Linus W. Brown, deceased. The described process of treating the species of crude petroleum obtained from oil wells in the State of California, for the purpose of separating the solid liquid and gas-



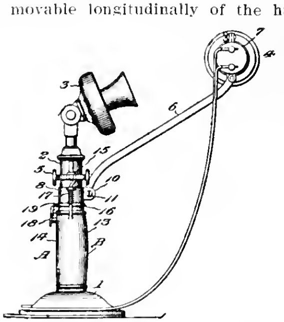
eous constituents from the oil proper, which consists in passing the crude oil in its emulsified condition along with steam through a common conduit, whereby they are thoroughly intermingled and the emulsion is broken up, and then allowing the steam and other gases to escape and discharging the solid and liquid products into a hot-water tank wherein the elements are completely segregated as described.

993,768. Liquid-Fuel Burner. James E. Dunkley, Los Angeles, Cal. A liquid fuel burner, comprising an elongated approximately cylindrical mixing chamber having logitudinal depressions in its outer side walls and having discharge slots in its outer side walls extending both above and below the depressions, the bottom walls of the depressions being imperforated, a mixing tube extending from one end to a point near the center of the mixing chamber along its under wall, the mixing tube extending slightly into the mixing chamber, a generating tube in the said depressions and adapted to form



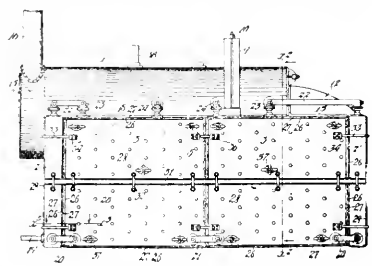
a passage around the sides and rear end of the chamber, an inlet valve adapted to control the admission of fluid to one end of the tube, means connected to the tube on the other end for injecting the generated vapor into the forward end of the air tube.

993,975. Telephone-Support. Charles E. Flynn, Vale Ore. The combination of a desk telephone set, a sleeve-shaped grip encircling and movable longitudinally of the handle of the



telephone, and an upwardly-extending member rising from the top of the sleeve and having means connecting with the receiver fork to actuate the same by the relative movement between the grip and telephone.

993480. Boiler. Samuel M. Walker, Los Angeles, Cal. A boiler comprising a cylindrical casing, a closed fire box formed of approximately rectangular hollow side and end sections, extending from the base to a point about half way up the sides and ends of the cylindrical casing, means for securing the side sections together, means for securing the end sections to the side sections, pipes and couplings connect-



ing the side sections, pipe and couplings connecting the end sections to the side sections, a supply pipe connected with the forward end section, pipes and couplings connecting the side and end sections with the cylindrical casing, an arched cover-plate resting on the top of the rear side sections and against the rear end of the cylindrical casing, and means for supporting the rear end of the cylindrical casing upon the rear side sections.

INDUSTRIAL

O-B THERMO BONDING PROCESS.

This is a simple, economical, rapid and effective method by which the terminals of standard O-B all wire compressed terminal rail bonds can be soldered to the rails after being compressed by the O-B compressor in the ordinary way, thus combining the great permanent conductivity afforded by soldering both head and stud of the terminal with the well-known mechanical strength and positive application obtained by compression.

obtained will be maintained without depreciating for an extremely long period of time under service conditions.

This filling in of the solder will remedy careless work on the part of the compressor gang where the bonds have not been compressed to the full extent (a not unusual occurrence) and thus make a permanently good joint out of the one that would inevitably soon lose all conductivity due to corrosion.

This process is equally effective for both new bonding and rebonding work.


Fig. 1. Ready for Ignition.


Fig. 2. During Reaction.


Fig. 3. Applying the Solder.

The extra tool equipment and materials required are simple and low in cost. The entire operation can be performed by one man in a very few minutes and it has been found possible to apply bonds by this process on roads having a two-minute headway without delaying the traffic.

The process consists of heating the bond terminal, after compression, and the adjacent web of the rail practically instantaneously, independent of cold or windy weather conditions, by a chemical reaction. The heat produced is so concentrated that while the terminal and the adjacent web are quickly brought to a soldering heat the ball of the rail remains so cool that the hand can be laid upon it while the soldering is being done so that no injury to the rail or to the body of the bond can possibly result. The solder enters at "C," Fig. 4, under the shoulder "B" of the terminal and firmly unites the entire shoulder "B" to the web of the rail, forming a fillet at "C" and thus positively sealing the joint against the entrance of moisture between the head of the bond and the web of the rail and uniting the compressed portions of the terminal to the annular walls of the hole in the rail.

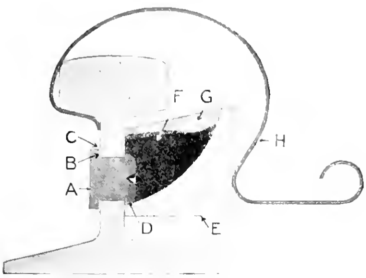


Fig. 4. Showing Application of Process.

The result is a greatly increased permanent contact area (B) and the positive sealing of the entire joint against moisture and corrosion so that the initial high conductivity thus obtained will be maintained without depreciating for an extremely long period of time under service conditions.

A number of the most expert bond men in the country have made trial installations, using this process, and have made tests extending over a long period of time of the results obtained as compared to compressed terminal bonding without this process and without exception the verdict has been that the increased permanent efficiency due to the O-B thermo bonding process is remarkable to say the least.

Complete instructions for using this process will be sent to proper parties on application and The Ohio Brass Co. of Marsfield, Ohio, would be glad to have their representatives make trial demonstrations on the tracks of companies who are in the market for rail bonds.

The Ohio Brass Co. has broad patents covering the process and its use is strictly limited thereby to the application of rail bonds furnished by that company only. The use of this process in applying bonds other than those supplied by The Ohio Brass Co. will constitute an infringement and be prosecuted by them as such.

NEW LUMINOUS ARC HEADLIGHTS.

The luminous magnetite arc which already has revolutionized street lighting systems is employed to great advantage in the new line of arc headlights for electric cars, developed by the General Electric Company. There are eight styles available, the different styles being specially designed to satisfy all the requirements and operating conditions obtaining in suburban, interurban and mining electric railways. All styles operate on the same principle, but differ in the details of construction and equipment necessary to furnish the character of illumination most suitable for the various classes of service.

The mechanism is arranged to maintain an arc of fixed length at the focus of the reflector, without requiring the motorman to make any electrode adjustments whatever. Furthermore, the well known characteristic of the luminous arc, to emit a reduced amount of light under reversed polarity of the electrodes, is utilized for dimming the headlights when operating within the limits of cities, towns and other populous districts. This feature is distinctly novel in the manipula-

tion of arc headlights, and completely eliminates the use of antiquated mechanical screens and other inconvenient methods.

It is recognized, however, that dimming by means of auxiliary incandescent lamps is satisfactory and preferred by some railway companies. Therefore, several styles are equipped with one or more standard 16 c.p. 110-volt incandescent lamps, connected in series with a suitable resistance for operation across the nominal railway potential.

The headlights for suburban cars operating on tracks having many curves and intersected by numerous roadways are equipped with parabolic reflectors of polished metal, for furnishing a broad fan of light which extends directly from the head of the car and 50 ft. on each side to a distance of about 1200 or 1500 ft. along the track. This character of illumination enables the motorman to see to some extent around curves, and also to detect the presence of pedestrians or vehicles approaching at right angles to the track. These headlights are provided with efficient heat resisting glass doors, which effectually protect the arc from draughts, and are equipped with spherical chimneys or shields for cutting off the objectionable side rays.

Where curves and intersecting roads are less numerous, and the cars operate at higher speeds, headlights equipped with mangin mirror reflectors are found very satisfactory. The mangin mirror furnishes a more concentrated beam of greater penetrating power than that of the parabolic reflector, and for satisfying the requirements of high speed suburban and interurban service it lies between the parabolic reflector styles and those equipped with semaphore lenses.

The latter are especially designed for high speed interurban cars operating on lines having long tangents. They furnish a brilliant beam of practically parallel rays, projected to a distance of about 2000 ft. ahead of the car. Since an interurban limited traveling at 60 miles an hour can be brought to a stop, by good braking, within a distance of about 1800 ft., these headlights afford an ample factor of safety at the highest probable operating speeds.

The semaphore lens is of the moulded plano-convex type. It consists of a series of circular sections arranged to give the best optical effect, and combines great strength with minimum weight. Its depth of focus enables it to be placed sufficiently far from the electrodes so that it is not affected by the heat of the arc. These headlights also, are arranged for in-town dimming either by the reversed polarity method, or by means of auxiliary incandescent lamps.

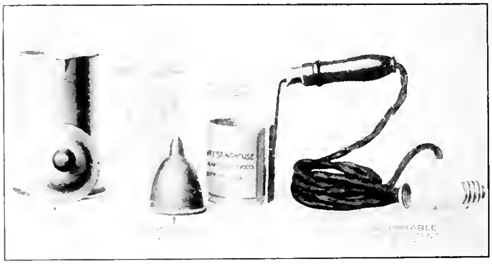
In all styles of headlights the positive electrode consisting of a stationary copper forging sheathed in a shell of non-oxidizable metal, has a life of 2000 to 3000 hours. The negative electrode, consisting of a tube of thin welded steel containing the mixture of iron oxide and other substances required for forming the luminous arc, has a life of 60 to 80 hours. The low rate of consumption of the electrodes serves to maintain the arc at the focus of the reflector and to keep it within safe voltage limits, without requiring the motorman to make any electrode adjustments. Furthermore, since the light of the luminous arc emanates from the entire arc stream composed of the highly incandescent vapors from the negative electrode, these headlights are much more efficient than those employing carbon arcs in which the source of light is limited to the incandescent tips of the carbons.

Unless otherwise ordered, all headlights are arranged to operate on a nominal railway potential of 550 volts with an 80 volt arc and a current of 4 amperes. The difference between the line and arc potentials may be controlled by resistances or by incandescent lamps. In the latter case the incandescent lamps can be acceptably utilized for lighting the interior of the car and the wiring can be easily arranged to permit of the interior lamps remaining lighted whenever the headlights are turned either on or off.

THE WESTINGHOUSE NURSERY MILK WARMER.

With the Westinghouse electric nursery milk warmer a bottle full of infants' food will be heated to the right temperature for the baby, in three minutes after the switch is turned on. Although intended primarily for heating infants' food, the milk warmer, without the bottle, can be used for heating or boiling any liquid and is convenient for heating water, for the sick room, for shaving, and for similar purposes. The water vessel holds about a pint and this quantity of water can be raised to the boiling point in about six minutes.

A heater of the Westinghouse cylindrical immersion type is used. When in use, the heater is wholly submerged in the water to be heated. All of the heat developed in the heater must, therefore, be transmitted to the water. The heating element (resistor) is hermetically sealed within the walls of the copper jacket forming the heater and is thus effectually protected against oxidization. The heater has an indefinite length of life if operated on normal voltage.



Exploded View of Nursery Milk Warmer.

By merely turning it to a position where a slot in the rim permits of its being taken out, the heater can be removed from the water vessel. All parts are accessible for easy cleaning as indicated in the illustration.

A nursery bottle and nipple of Hygia manufacture are supplied with each warmer. While being heated, the bottle sets in a water bath and in the cylindrical heater which, in turn, rests in the water vessel. The water bath is an important feature of the heater, as infants' food cannot be burned and thereby rendered indigestible if heated in a water bath.

A current tap attachment plug is furnished with each milk-warmer outfit. This plug screws into any Edison base lamp socket and has itself a lamp socket and a socket to accommodate the plug on the milk warmer cord. By using it, the warmer and an incandescent lamp can be operated from the same outlet. The warmer takes 500 watts and operates with either alternating or direct current.

NEW STORAGE BATTERY CARS.

The Electric Storage Battery Company of Philadelphia has closed a contract for the battery equipment of the 35 new storage battery cars for the Dry Dock, East Broadway & Battery Railroad Company of New York City to be placed in service on their lines during the early summer.

These new cars have been specially designed by the Third Avenue Railway Company to give the necessary strength with minimum weight. Each car is equipped with two motors and the batteries are installed under the longitudinal seats.

The cars will give a maximum speed of 15 miles an hour on level track with a schedule speed of seven to eight miles an hour including stops. They are of the open platform single truck type with 18-foot car bodies.

The battery equipment of each car consists of 58 cells of Type 29 MV "Hycap-Exide."

NEWS NOTES

FINANCIAL.

CHINO, CAL.—The City Council has passed an ordinance issuing bonds in the sum of $40,000 for the purpose of acquiring a complete municipal water plant and system.

SANTA PAULA, CAL.—The city clerk will receive sealed bids up to July 17 for a franchise to construct and operate for 30 years a conduit, main or pipe line along certain portions of streets and highways of the city.

SANTA BARBARA, CAL.—The City Council has sold $40,000 worth of municipal bonds to the Santa Barbara County National Bank for a premium of $233.50. The money is to be used in waterworks extensions.

RIVERSIDE, CAL.—A meeting will be held at the office of the Riverside Water Company on August 1, 1911, for voting on the proposition of issuing bonds in the sum of $750,000 for enlarging and perfecting the water system.

TROY, IDAHO.—The Council has passed an ordinance authorizing the call of an election in Troy for the purpose of authorizing the issuance of $12,000 in bonds to be used for the purpose of constructing a system of waterworks.

SACRAMENTO, CAL.—The City Board of Trustees has adopted a resolution clearing the way for calling an election for the purpose of voting bonds in the snm of $200,000 to purchase and install a new pumping unite for the city waterworks department. It is expected that the election will be held some time in July.

SAN FRANCISCO, CAL.—In a decision handed down last week by the Supreme Court, Los Angeles was given the right to issue bonds to the extent of $3,500,000 authorized by the vote of the electors April 19, 1910, for the purpose of building and maintaining its own heat, light and power company. An injnnction obtained by Percy H. Clark, which had been decided in favor of the city and then was appealed to the Supreme Court, was dissolved when the Supreme Court sustained the verdict of the lower court, which had given judgment on a demurrer filed by the city attorney a year ago. Clark contended that the city had no power to engage in the enterprise projected, but the Supreme Court held this untenable, as an amendment to the Los Angeles charter in 1909 gave the power and the right to secure lands, water rights, machinery and all else needed. Clark also contended that the bonds would give Los Angeles an indebtedness beyond the fixed limit, but this also was overruled, the court decided, by a special amendment to the charter making provision for public utilities.

INCORPORATIONS.

HERMISTON, ORE.—The Hermiston Farmers' Exchange Telephone Company, capital $10,000, has been incorporated by W. H. Skinner, Geo. H. Cressy, et al.

SAN FRANCISCO, CAL.—California Land and Water Co., $25,000; shares $1 each, subscribed $500, by M. E. Miller, W. L Wilson, E. G. Straub, H. Woods and O. S. Strain, 1 share each.

VANCOUVER, WASH.—The Washington Engineering & Securities Company, capital $3,500,000, has been incorporated by E. M. Scanlon and James P. Stapleton of this city, with the help of several New York capitalists. The intention is to operate all kinds of plants to distribute light and power, at this place.

McMINNVILLE, ORE.—McMinnville Mutual Telephone association, principal office, McMinnville, Ore.; capital stock, $1000.

LOS ANGELES, CAL.—Annex City Water Company, $75,000, subscribed $30, by B. G. Adams, E. H. Adams and W. C. Murray.

SAN FRANCISCO, CAL.—Perpetual Germ Proof Telephone Mouthpiece Co., San Francisco; $75,000, shares $1 each, subscribed $500, by E. J. Leiter, F. Rittigstein, J. L. Jannet, M. F. Rapp and W. M. English, 100 shares each.

STOCKTON, CAL.—Joaquin Delta Railway Company, Stockton, $500,000, subscribed $40,000, by E. W. and L. H. Woods. Frank West and E. L. Wilhoit of this city, W. P. Plumer, I. L. Borden and M. E. Cerf of San Francisco.

HALF MOON BAY, CAL.—Half Moon Bay Light & Power Company, Moss Beach; $25,000, subscribed $12,500, by J. J. Gomez, M. Codivo, Ben Cunna, Joe Fernandez and F. N. Staley. A power line has been surveyed from San Mateo nnder the direction of Sidney Sprout, consulting engineer.

ILLUMINATION.

CLARKSTON, WASH.—At the council meeting last week the Lewiston-Clarkston Improvement Company made application for a 50-year franchise for light and power.

LACROSSE, WASH.—Harry C. Wilson, proprietor of the Lacrosse chop mill and lessee of the local waterworks system, contemplates the installation of a 150-light 16 c. p. electric plant.

TULARE, CAL.—The Tulare County Power Company, C. H. Holly, manager, has made application for a franchise to establish and maintain poles, wires and other electrical appliances in this city.

SEBASTOPOL, CAL.—A contract has been entered into with the Neptune Meter Company to furnish the town with Trident No. 3 disk meters for one year at a cost of $8.60 for each meter.

LOS ANGELES, CAL.—The Southern California Edison Company has filed application with the war department through the Los Angeles United States engineering offices, for permission to erect a transmission line across Cerritos slough, west of Long Beach harbor. The company agrees to maintain the cable on towers at least 140 feet above the water.

SAN PEDRO, CAL.—Plans for a new light and fog signal station to be built at end of the breakwater are now completed and work on the new structure will begin shortly after July 1, at which time the appropriation of $36,000 made by congress for it will be available. Plans call for a structure of reinforced concrete and boiler plate. The equipment will consist of flashing light and fog siren, the light to be visible for eighteen miles.

MEDFORD, ORE.—That the Siskiyou Light & Power Company will bring their power line from the Fall Creek plant to Ashland and distribute current in the Rogue River Valley in connection with the Condor Power Company is now certain. Engineer Harvey J. Sarter has finished the Ashland end of the permanent survey and Engineer John C. Boyle will complete the Fall Creek end this week. General Manager Orlo G. Steel was in Ashland several days last week arranging for the immediate construction of the line. The first work is

the clearing of a 75-foot right of way. The line avoids the heavy timber and the distance between Ashland and Fall Creek is 23 miles. Mr. Steel states that 200,000 pounds of No. 2 copper wire and 5000 insulators are en route from New York. Red fir poles 44 feet high and 7 inch tops have been ordered and they will be put on top of concrete bases. The line will be of special wooden tower construction, 10 towers to the mile. The transmission line will carry current at 60,000 volts. The power line will cost approximately $50,000 though other expenses connected with it will require an additional $25,000. When completed it will tie into five different plants operated by subsidiary companies, affording opportunities to fall back on in case of emergencies. The line will be connected with the Ashland Electric Light & Power Company's plant in Ashland in the fall.

TRANSMISSION.

PALA CEDRO, CAL.—Sixty tons of freight lies here awaiting shipment to the Northern California Power Company's power plant at Kilarc, near Whitmoore. The plant is to be increased from 5000 h.p. capacity to 8000 h.p.

LEWISTON, IDAHO.—It is reported that the Lewiston-Clarkston Improvement Company will in about a year erect a sub-station east of the city and rebuild the high power station line serving the city. It has been announced that the company is laying plans for the development of their power site on the Grande Ronde river.

CONCONULLY, WASH.—A franchise has been granted to J. C. Morton for the construction of an electric light plant and waterworks. Work will start at once on the electric light plant and waterworks system which will be completed at the expiration of the year. Both plants will cost $10,000. The electric plant will at present be operated with steam, later water power will be used.

VANCOUVER, WASH.—Fire of unknown cause originating in the boiler room totally destroyed the Vancouver power plant of the Portland Railway, Light & Power Company on June 4, causing a loss of $63,000; insurance, $35,000. Little inconvenience was caused consumers of light and power, the company placing in use an emergency cable, bringing current from the Portland plant.

MANTON, CAL.—Chadwick & Sykes the contractors who were to finish the Colman ditch, have turned the work back to the Northern California Power Company. A. H. Clough, the civil engineer for the company, will take charge of the work again. The Colman power house is completed, and all the machinery has been installed, but the ditch will not be finished before the first of the year.

SAN FRANCISCO, CAL.—Architect Willis Polk is now preparing the plans for a reinforced concrete power station which is to be erected for the San Francisco Gas & Electric Company on Bush street, near Larkin. The new building will be used as a substation for the company's power distribution. The cost of the work has been estimated at $15,000. The plans will be ready for figures in a short time.

BODIE, CAL.—The plant of the Pacific Hydroelectric Power Company, at Mono Lake has been completely restored and power is again being furnished cities of Southern Nevada. This plant was destroyed last March by snowslides, which tore away the power plant and lines and caused the death of several people and injury to others. The plant supplies power and light to Bodie, Lucky Boy, Aurora, Rawhide, Fairview and other camps in Nevada.

VICTORIA, B. C.—Bids will be received by W. L. Coulson, general manager of the Canadian Collieries, Ltd., up to June 26 for furnishing and installing two direct connected hydro-electric units at the company's power house at Comox, B. C. Bids will be received on the same date for construction work necessary on the installation of hydroelectric power on the Puntledge River, Comox. Work to embrace clearing, construction of dams, flume, pipe line and power house.

OROVILLE, CAL.—County Recorder J. A. Tyler is in receipt of an order from C. D. Marx, chairman of the State Board of Control of Water Power, instructing him not to record any more water right locations and requesting a copy of all location notices filed in the Recorder's office sixty days prior to and sixty days after the new conservation measure went into effect. During the last winter, while the waterpower measure was pending before the California Legislature, representatives of the Great Western Power Company and the Oro Light & Power Company forestalled the action of that body by filing on hundreds of thousands of inches of water in the North Fork watershed. These filings, with others, aggregated in the neighborhood of 800,000 miner's inches, and having been made prior to the bill becoming effective, it is not thought anything can be done in the matter. The new law approved April 8th places all water rights under the supervision of the State Board of Control in Sacramento.

PORTLAND, ORE.—The Pacific Power & Light Company, already owning and operating about 90 public utilities in the Pacific Northwest, is approaching the local field in its sphere of influence. Through as associated corporation, the Electric Bond and Share Company, of New York, it has just organized and incorporated the Washington Engineering & Securities Company, with headquarters at Vancouver, Wash. It is capitalized at $3,500,000, divided into 35,000 shares of $100 each and its charter allows it to operate all kinds of industrial plants and to engage in the distribution of light and power and to operate electric transportation lines. This is the first move this syndicate has taken toward getting a foothold in the immediate vicinity of Portland. It owns the street railway, electric light and gas plants at Astoria and practically controls the entire public utility fields of more than a score of cities in Eastern Oregon and Washington. The new syndicate will come as a strong factor in the Vancouver field which is already being served by the Portland Railway, Light & Power Company and the Mount Hood Railway & Power Company. These corporations control all the public service franchises which have been granted by the Vancouver Council and so far as is known the new concern has not shown its hand as to what its intentions are toward further exploitation of that field. It is known, however, to have unlimited Eastern capital behind it.

TRANSPORTATION.

TACOMA, WASH.—Frank E. Ross of this city announced that preliminary plans have been completed for the construction of an electric railroad from Gig Harbor to the Straits of Juan de Fuca. Survey has been completed and part of right of way secured.

PORT ANGELES, WASH.—Various commercial bodies of the Olympia peninsula will meet here and discuss plans for the organization of a company to construct an electric railway from Lake Crescent through to Hoods Canal, via this city.

OAKLAND, CAL.—Sixty pay-as-you-enter cars will be put into service by the Oakland Traction Company within the next month. The new cars, which will resemble those being used by the United Railroads in San Francisco, are on their way to Oakland from the car shops in St. Louis, and are expected here within three or four weeks. They will be put into service on the various lines immediately upon their arrival. No announcement has been made as to which lines the cars will be put into service.

WENATCHEE, WASH.—The City Council will probably grant a franchise to the Wenatchee Traction Company at their next regular meeting, permitting the company to operate an elecric line in this city.

BERKELEY, CAL.—Announcement was made that the Oakland Traction Company will start at once on the double tracking of its Northbrae line, from University and Grove to the southern boundary of the Spring estate.

HAYWARDS, CAL.—The Board of Trustees has adopted an ordinance granting I. B. Parsons, and his assigns a franchise to construct and operate for 30 years, a single or double track, standard gauge railroad by electric or any other than steam, animal or cable power, over and across certain streets in the town of Haywards.

RIVERSIDE, CAL.—The City Council has received a formal request from the Pacific Electric Railway Company for a franchise for an electric line over Magnolia avenue. The city attorney was instructed to draw up a franchise covering the thoroughfare.

RAYMOND, WASH.—Ray Fulcher, construction engineer for Sanderson & Porter, the New York engineering concern controlling the Grays Harbor Electric Company, is here preparatory to assembling a crew to inaugurate construction work on the Raymond-South Bend electric line. It is probable that other electric lines to tap agricultural and timber lands will follow.

NAPA, CAL.—Announcement is made by Superintendent M. McIntyre of the San Francisco & Napa Valley Electric Railway, that the line will be extended to Calistoga in the immediate future. The company has already begun the erection of a bridge across York Creek, at the present terminus of the line at St. Helena, and as soon as the steel arrives from the East the construction of the track north to Calistoga will commence. The improvement was made possible by the recent reorganization of the road, when a new $1,000,000 bond issue was authorized.

MODESTO, CAL.—Six carloads of ties have arrived in Modesto and were consigned to the Tidewater & Southern Railroad Company, which is building an electric line from Stockton to Merced, passing through this city. The campaign for subscriptions for the purchase of bonds has progressed to such an extent recently that the officials of the road are now confident that the line will be in operation before the close of the year. The Board of Trustees of Modesto has granted a franchise to the company for a right of way along Ninth street, running parallel with the Southern Pacific line.

WATERWORKS.

LOS ANGELES, CAL.—The Department of Public Service is receiving sealed bids for furnishing fire hydrants to the city.

NORTH YAKIMA, WASH.—Water main extensions have been decided on by the officials of the Pacific Power & Light Company.

SAN DIEGO, CAL.—The Department of Finance, Ways and Means is receiving sealed bids for furnishing cast iron water pipe to the city.

ESCONDIDO, CAL.—The Directors of the Escondido Water Company have rejected bids submitted for furnishing supplies to the company.

VANCOUVER, WASH.—The Washington-Oregon Corporation, which controls the water and gas plants of this city, plans $400,000 improvements to the same.

TACOMA, WASH.—Fifteen bids on the final unit of the Green River gravity water system have been received by Commissioner of Light & Water Nicholas Lawson. P. E. McHugh of this city submitting the lowest bid.

PASCO, WASH.—The contract for furnishing the pipe for the water system for Sylvester's Addition has been awarded to the Washington Pipe & Foundry Company of Tacoma.

PASCO, WASH.—An ordinance has been passed by the council authorizing the city attorney to institute condemnation proceedings against the Pacific Light & Power Company for the purpose of acquiring the waterworks system.

PORTLAND, ORE.—Bids will be received by the Water Board of Portland to June 13th for furnishing 200 fire hydrants f. o. b. cars, Portland, Ore. Specifications to be obtained at the office of D. D. Clarke, Engineer of Water Board.

CORVALLIS, ORE.—Engineer Miller of Seattle, the designer of the mountain water system of this city, has developed a plan for improving the intakes to prevent clogging in time of high water. Superintendent Strange will take personal charge of the construction work.

TACOMA, WASH.—Bids are being received at the office of the commissioner of Light & Water, City Hall, Tacoma, Wash., for furnishing and delivering all materials and for the construction of water mains in local improvement district No. 573, according to plans and specifications on file.

HAINES, ORE.—The $20,000 bond issue providing for a municipal water system, has been sold and a contract for the entire system with the exception of drilling the well, has been awarded to G. H. Sutherlin & Co., of Walla Walla, for $15,453. Thos. Leffler of Haines was awarded the contract for drilling the well.

PORTLAND, ORE.—A 12 inch main will be laid on East Water street before the pavement is laid down, and large mains will be laid on East Third street and Union avenue, East Oak and East Salmon streets. Paquet, Giebisch & Joplin have submitted the lowest bid for laying the large cast iron main on Lincoln street from East Sixteenth to Marguerete avenue to supply the high service direct from the new reservoir.

OAKLAND, CAL.—W. F. Kelly, up to May 1st general manager of all the lines of the Oakland Traction Company and the Key Route system properties, in which F. M. Smith, the "borax king," is greatly interested, is now a director of the People's Water Company, of which Frank C. Havens is president. Kelly was elected to the office at a meeting of the board of directors May 18th, his name being proposed to fill the vacancy left through the resignation of George N. O'Brien of Berkeley.

SPOKANE, WASH.—W. A. White, chairman of the finance committee of the Washington Water Power Company, Spokane, Wash., has outlined as follows work to be undertaken by the company at Spokane: Large amounts of money have been provided to develop the large power station at Long Lake and the Spokane & Long Lake Railway and to complete the Little Falls plant, purchase additional cars and equipment, extend the local distributing lines within the city, install storage batteries, extend the underground conduit system and complete the transmission line from Post Falls.

TACOMA, WASH.—The Council has adopted a resolution providing for placing a 6 inch cast iron water main on Carr street, from Yakima avenue to North Thirtieth street, according to plans and specifications to be prepared by the Commissioner of Light and Water. The Council has also adopted a resolution providing for the construction of 8 inch wooden water main on South Sixty-sixth street from Huson street to Orchard street, a 6 inch wooden water main on South Sixty-second street from Ferdinand street to Orchard, and a 6 inch wooden water man on Huson street and Orchard street, from South Sixty-second street, to South Sixty-sixth street, according to plans to be prepared by the Commissioner of Light and Water.

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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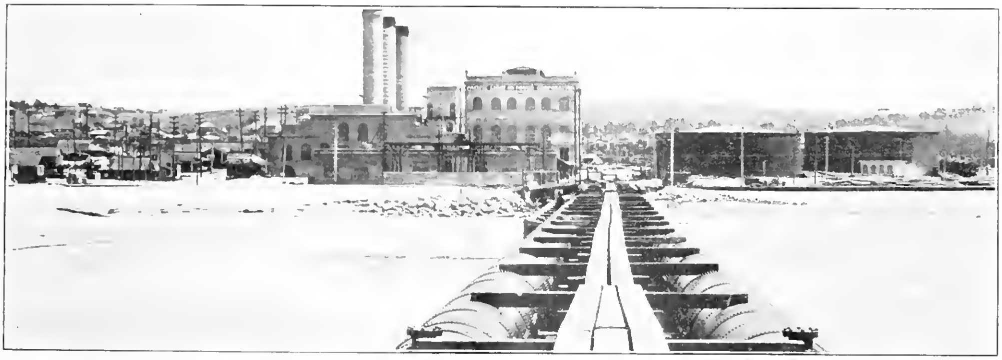


The Redondo Power Plant

ENLARGEMENT OF THE REDONDO PLANT

BY A. H. HALLORAN

The Redondo plant of the Pacific Light and Power Company at Redondo Beach, near Los Angeles, California, is operated as a steam auxiliary to the Kern River and other hydroelectric plants by which this company supplies light and power throughout Southern California. While electric power may be more cheaply generated hydraulically, the continuity of service demanded from this great system requires an almost equal steam power capacity. The Pacific Light and Power Company supplies the current for the far-famed electric railway system of Los Angeles, whose perfection of service is in a large measure due to the constancy of power supply.

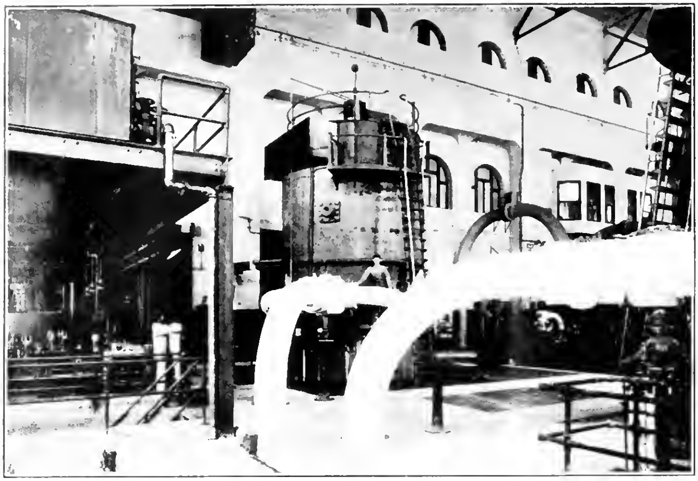
The original Redondo plant, as completed just three years ago, had a capacity of 15,000 kw., there being three 5000 kw., 60-pole General Electric alternators furnishing three-phase current at 18,000 volts, 50 cycles and driven at 100 r.p.m. by three 34x70x56 combined double horizontal and vertical, compound, side-crank, McIntosh & Seymour automatic grid-iron valve engines. This plant was fully described in the Journal of Electricity, Power and Gas of August 22, 1908.

The increased business of the Pacific Light and Power Company has necessitated not only the extension of their Kern River system in the Sierra Nevada Mountains, but also the enlargement of their auxiliary steam power capacity. The latter has been accomplished by the installation of two steam turbine units which it is the purpose of the present article to describe.

The two new 15,000 k.v.a. steam turbine units have been installed in the west end of the main power house which formerly contained the pump pit and the circulating water system which has now been housed in a separate building nearer the beach line. The new work, as performed under the direction of J. G. White & Co., involved the design and installation of two 15,000 k.v.a. turbo-generators and auxiliaries, eight boilers, a 125-foot concrete stack, an extension and rebuilding of the circulating water system, necessary piping and the switchboard control apparatus.

Turbo-Generators.

Power is generated by two General Electric type ATB 8-pole alternators driven at 750 r.p.m. by vertical Curtis turbines with condenser base. The generators are rated at 15,000 k.v.a. and supply three-phase current at 50 cycles and 9000 volts. As the reciprocating units of the old plant delivered current at 18,000 volts, which is also the voltage of transmission, the turbo-generator voltage is raised from 9000 to 18,000 by means of six General Electric single-phase compensators, Y-connected, oil and water cooled. A spare compensator is also provided. Excitation current is derived from a 100 kw. 4-pole General Electric horizontal turbo-exciter, the normal excitation being 60 kw. at 250 volts.



Operating Floor, Showing Turbo-Generator Units No. 5 and No. 1

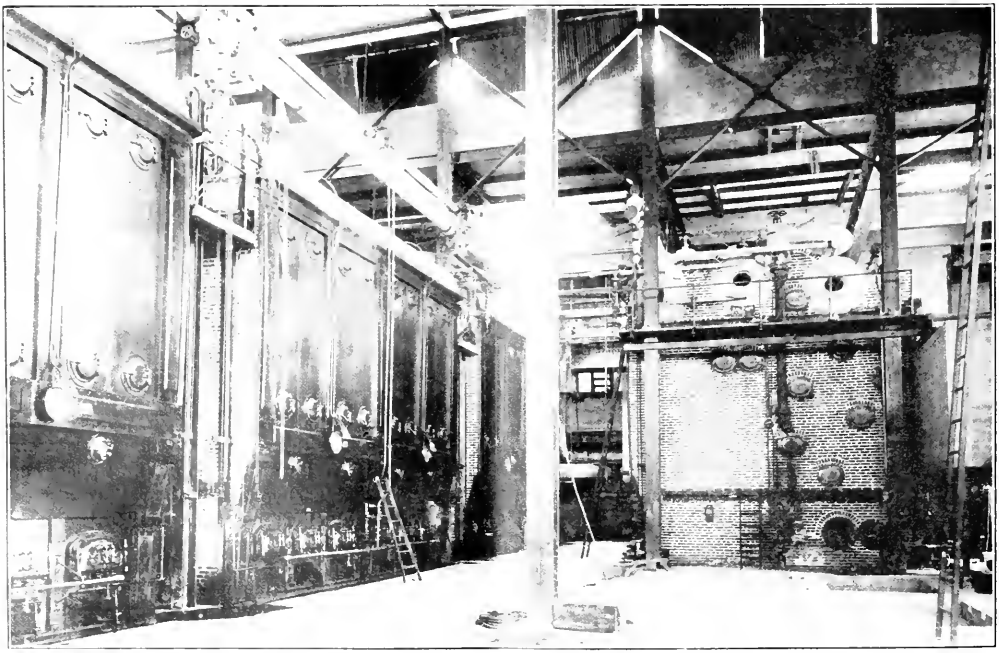
This unit is driven at 2400 r.p.m. and is operated non-condensing.

Oil is supplied for the bearings and valve gears by three steam driven horizontal duplex pumps designed for an operating pressure of 1000 lb. per sq. in. and manufactured by Dean Bros.

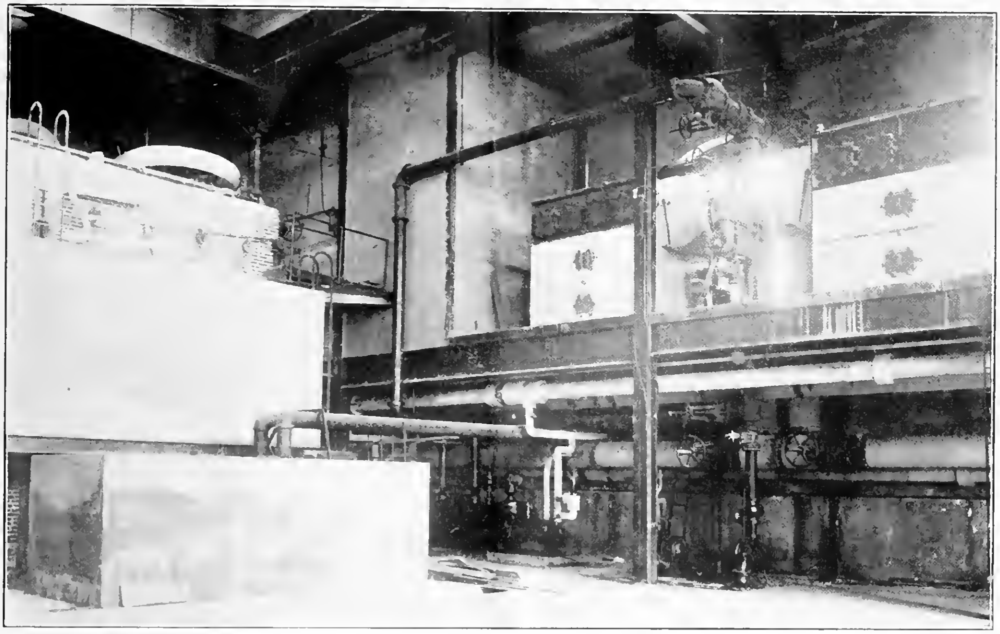
Boilers.

Superheated steam is supplied by eight 601.9 h.p. Stirling water-tube boilers, type 0-24, arranged in four batteries of two each and burning fuel oil. This type of boiler as is well known, consists of three upper steam drums, resting in saddles and supported by I beams, and a lower mud drum sustained by the steel tubes which connect it to the steam drums above, thus allowing for expansion and contraction. The steam drums are 42 in. in diameter and 14 ft. 10 in. long, the mud drum 48 in. in diameter and 13 ft. 7 in. long. Each boiler contains 432 hot-rolled seamless tubes, $3\frac{1}{2}$ in. in diameter, and designed for working pressures of 200 lb. per sq. in.

Each boiler is equipped with one Babcock & Wilcox forged steel superheater designed to given 100



New Boiler Installation.



Feed Water Heaters.

degrees F. superheat at the boiler nozzle when operating at or above rating and 190 lb. gauge pressure. Peabody patent fuel oil burning furnaces and Hammel oil burners are installed in each boiler, there being three burners per boiler.

The make-up water for the plant is supplied from wells on the property and is purified and pre-heated by two 10,000 h.p. Cochrane vertical feed water heaters and purifiers, right and left handed. The boilers were supplied and installed by Chas. C. Moore & Co., engineers, who will also install ten more similar units.

Stack.

The reinforced concrete chimney, as designed by C. Leonhardt, is similar in appearance to the two already installed. Its dimensions are:

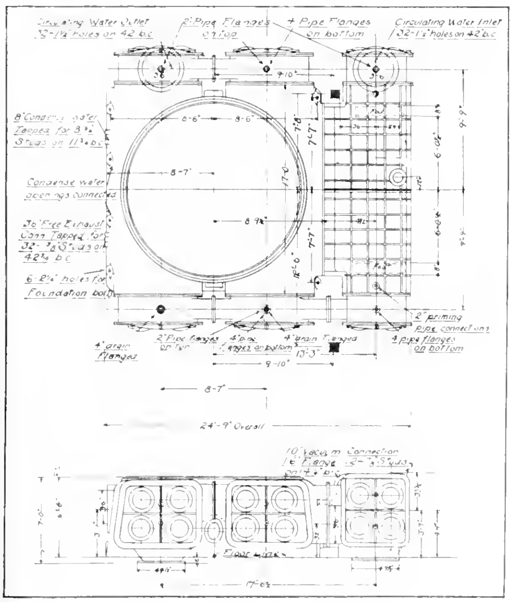
Height above boiler room floor line	125 ft.
Depth of foundation below boiler room floor line	6 "
Width of square part of foundation	24 "
Height of square part of foundation	5 "
Inside diameter of top	13 "
Height of inside lining	51 "
Thickness of wall at top	7 in.
Thickness of wall at base	10 "

The foundation concrete is composed of one part Portland cement, three parts sand and five parts stone (2 in.). The chimney concrete is made up of one part Portland cement, two parts sand, three parts stone (¾ in.). The foundation reinforcement consists of two cross layers of steel bars; the first network being placed about 6 in. from the bottom with its bars running diagonal to the sides. Reinforcement of the shaft consists of vertical bars with horizontal rings placed 14 in. apart with additional reinforcement at all openings. All the chimneys are provided with two 18x30 in. clean-out doors.

The Condensers.

The most interesting and novel feature of this plant is the system of condensation whereby the high vacuum is obtained upon which the efficient operation of the steam turbine is so dependent. The condensers are of the surface type, the steam being condensed by coming in contact with metal tubes through which cold water is constantly circulated.

The main condenser for each of the turbines is in the base of these machines, there also being an auxiliary condenser with connecting water and steam pas-



Plan of Main and Auxiliary Condensers.

sages thereto. The total cooling surface of each condenser is 24,000 sq. ft. and consists of 5100 copper-zinc tubes, one inch in diameter and 18 ft. long, a total length of over 17 miles, two-thirds being in the main and one-third in the auxiliary condenser. The water first circulates through the auxiliary condenser and then passes to the main, the steam passing in the opposite direction.

The vacuum produced by the condensation of steam into water is augmented by exhausting the air and other non-condensed vapors from the condenser steam-space by means of dry-vacuum pumps, there being one for each condenser. Such vacuum pump is merely an air compressor compressing from say 28 inches of vacuum (1 lb. absolute) to atmospheric pressure (14.7 lb. absolute). The air suction is taken from the auxiliary condenser, which is furthest from the entering stream, the air therefore having minimum temperature and least volume, and is thence discharged to the atmosphere. Each of the vacuum pumps are of the horizontal straight-line crank and fly-wheel type, 10x30x24 in., having one steam cylinder fitted with non-releasing Corliss gear and one air cylinder equipped with semi-rotative valves, each base condenser being provided with a 30 in. horizontal automatic atmospheric relief valve.

The two condensed water pumps on each turbine are 5 in. centrifugals, one motor-driven and the other direct-connected to and driven by a non-condensing steam turbine, the latter being for emergency use. These pumps draw from the main base condenser which is nearest the entering steam and the water is then discharged at the maximum temperature.

This equipment maintains a vacuum of from 1 to 1½ in. absolute according to conditions. It was furnished by the Alberger Condenser Co. of New York and installed by Braun, Williams & Russell of San Francisco.

High Pressure Piping.

The high pressure piping includes all steam piping, high pressure drip, boiler-feed piping, blow-off piping, steam piping for the oil burners, the boiler cleaning line, oil step-bearing discharge and guide-bearing pump discharge. It was all tested with 400 lb. hydrostatic pressure, except the step-bearing oil piping which was tested to 1500 lb. All steam piping is designed for 200 lb. pressue and 150 degrees F. superheat.

Full weight steel pipe is used throughout, all sizes above 4 in. being made up with forged steel Van Stone type flanges. All gaskets are of corrugated steel to withstand the high temperature of superheated steam. The large steam valves and flanged steam fittings are of semi-steel, the smaller valves are of bronze and the fittings of cast iron.

The steam valves on the turbine mains are operated and controlled hydraulically from the engine-room floor.

The main steam piping connecting boilers and turbines consists of a series of bends which are securely anchored to the steel work of the building, and which absorb all expansion. In the smaller steam lines expansion is taken care of by means of slip joints.

The boiler feed piping is made up of cast iron pipe ¾ in. thick. This was selected because the steel boiler feed piping in the old plant was found to rapidly deteriorate. All boiler feed valves have bronze stems, bronze seats and bronze faced disks.

The boiler-washing lines are covered by the same specifications as the boiler-feed lines. The blow-off piping is likewise covered by the same specifications as for the main steam piping. Special ties were designed giving a large sweep from each boiler blow-off into the main line. Separate connections are made from each boiler for carrying away water used in washing the boilers. These discharge directly into the open trench. This arrangement eliminates the danger of scalding men while cleaning a boiler, by the opening of a blow-off on a live boiler.

High pressure drips similar in design to the high pressure piping are run from all points where condensed steam is liable to accumulate. Squires steam traps return the water to the feed water heaters. The steam piping for the oil burners is similar to the other steam piping. The piping for conveying lubricating oil to the vertical guide bearings of the turbine, is of the same weight as steam piping, but all is galvanized to insure absolute freedom from scale which would be very injurious to bearings. The piping for conveying oil from the step-bearing pumps to the step-bearing of the turbine, is required to stand a working pressure of 1500 lb. per sq. in. which is the pressure of oil required in the step-bearing to support the turbine. Double extra heavy seamless drawn annealed steel tubing is used for this purpose. Valves are of the gate type similar to those used for very high head hydraulic work. Bends are used where possible, eliminating fittings and all joints are made with special grooved flanges.

Low Pressure Piping.

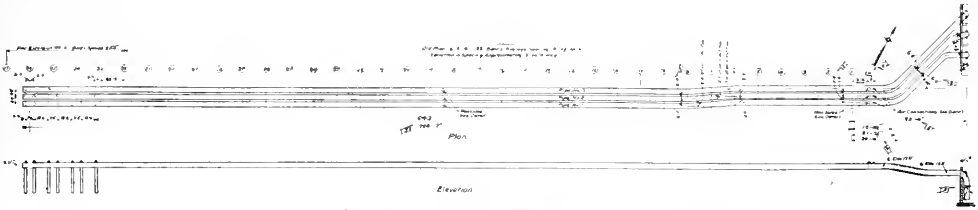
The low pressure piping consists of the auxiliary exhaust, water supply, heater vents and mains, hot well pump suction and discharge, oil lubricating system, oil feeder and air pump cooling lines, oil piping to burners and compressed air line. The large atmospheric exhaust pipes leading from the relief valves in the condenser are of riveted steel, as they are used only occasionally in emergency.

All auxiliary exhaust piping is of standard weight steel pipe with screwed cast-iron flanges. All valves and fittings are of cast-iron.

The water supply piping throughout the plant, the hot well pump suction and discharge, the air pump cooling water lines and the oil filter piping are of cast iron in sizes 4 in. and over and of galvanized steel in smaller sizes.

The heater vents, the oil piping to oil burners, the compressed air lines, the air pump suction and discharge, all cylinder pipes, lubricating piping, etc., are standard weight and similar to the auxiliary exhaust. All lubricating piping has been galvanized to eliminate scale. The expansion in all low pressure lines is taken care of by Wainwright corrugated copper expansion joints. All pumps are controlled by Fisher automatic regulators, and are fitted with anti-corrosive relief valves.

All piping throughout the station is supported at intervals of about 12 in. by adjustable steel hangers, or brackets, and is securely held against vibration or expansion by specially designed anchors and braces. The large pipes for the salt water condenser circulating systems are all of riveted steel. Braun, Williams

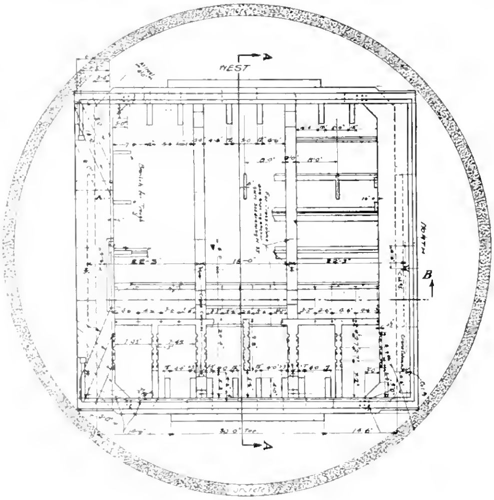


Pier for Circulating Water System.

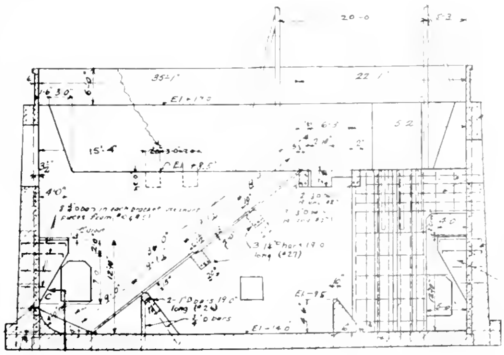
& Russell of San Francisco are the contractors for the entire piping system. Most of the valves were manufactured by Crane Company and the balance of the material came from various firms.

The Circulating Water System.

The circulating water for the condensers is obtained from the Pacific Ocean, a 620 ft. pier gaining the necessary depth for suction at low tide. The salt water for the reciprocating engines was originally pumped direct from the ocean through two 50 in. steel pipes the power house by centrifugal pumps therein, giving a combined suction and discharge piping length of 1700 ft. So much trouble was experienced with seaweed that it was decided to extend the pier 100 ft. further to deeper water, thus considerably reducing the amount of seaweed. Furthermore a large double screen chamber has been constructed near the beach at an elevation of 15 ft. above mean high-water level. The water is delivered to this screen chamber by three 54 in. steel siphon pipes. To the following description of the screen chamber and the novel manner in which it was constructed the writer is indebted to Mr. C. R. Guertler, construction superintendent for J. G. White & Co.



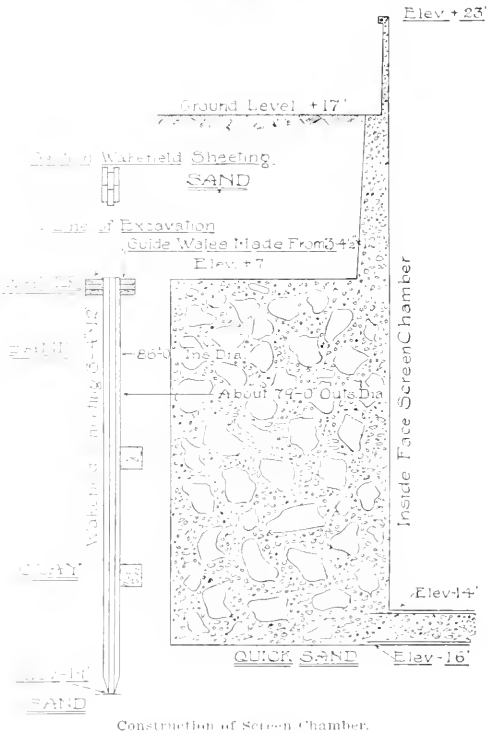
Plan of Screen Chamber.



Cross Section of Screen Chamber.

The screen chamber is a rectangular reinforced concrete structure 58x52 ft. inside and extending from the ground level, about + 17 to — 16 ft. below sea level. Two reinforced concrete walls divide it into three equal compartments in which are contained the seaweed racks and finer screens. The sides not braced by these division walls are sustained by a horizontal girder near their top over 7 ft. thick and heavily reinforced.

On beginning this structure the question arose whether to build a rectangular coffer dam with cross bracing or a circular one without any internal bracing, other than walling. The failure of much smaller circular coffer dams previously built caused grave doubts



Construction of Screen Chamber.

about the feasibility of a circle 86 ft. in diameter; but the simplicity, cheapness and convenience of an unobstucted area to build in, together with the uniformity of the earth to be supported, finally carried the decision for the circular unbraced coffer dam.

Mules and scrapers removed the first 10 ft. of sand, and the coffer dam began at that point. The contractor first set two circles of light walling built up of three thicknesses of 2 in. stuff, one inside and one outside as a guide; and drove between them with an ordinary pile driver and pile-jet outfit, 26 ft. lengths of Wakefield piling built each of 3/4x12 in. pieces of Oregon fir. These were plumbed and driven with the greatest possible care, and final excavations proved them to be as true and tight at the bottom as they were at the top.

The excavation was done by hand loading plain cu. yd. boxes with hinged bottoms and hoisting them by a guyed derrick. Two-thirds of the way down the excavation exposed a prehistoric marsh in the form of peat. Under this was a water tight semi-clay, but just before the required depth was reached this clay unfortunately gave place to quicksand full of spouting springs. Three centrifugal pumps one 5 in. and two 6 in. were installed, but the great amount of water encountered made it necessary to remove the clay blanket in sections and place the concrete in blocks about 18x10 ft., bringing joints under division walls.

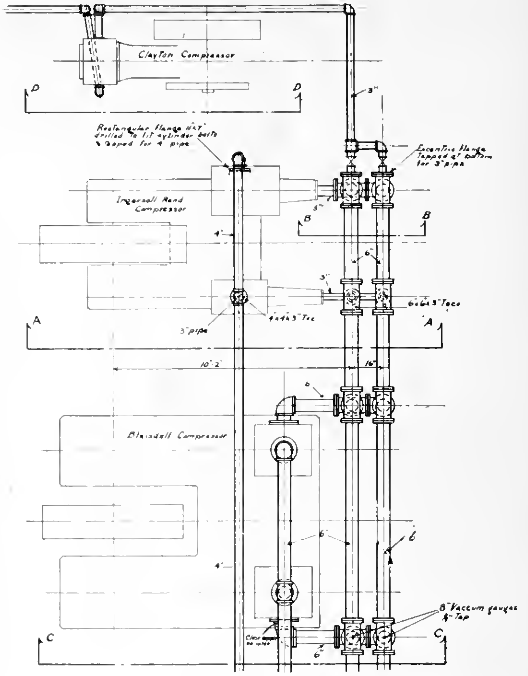
During these operations the coffer dam moved quite appreciably, coming in all around about 3/8 in. a day until the guide wallings around the top were in some places crushed. As soon however as the sheeting had squeezed together so as to exert an arch action on the ground the movement practically ceased. As close as could be measured the complete coffer dam probably closed in a total of 2½ or 3 in. Two wallings placed near the bottom and built of 16x16 in. segments butted and jacked into place, and finally wedged with hard wood held without the least sign of deformation.

The spouting springs made it necessary to lay the concrete dry on a 2 in. planking, forcing the water ahead. In the worst places canvas tents were sacrificed to lay down over the springs. Once the whole bottom slab was placed, however, all difficulty disappeared.

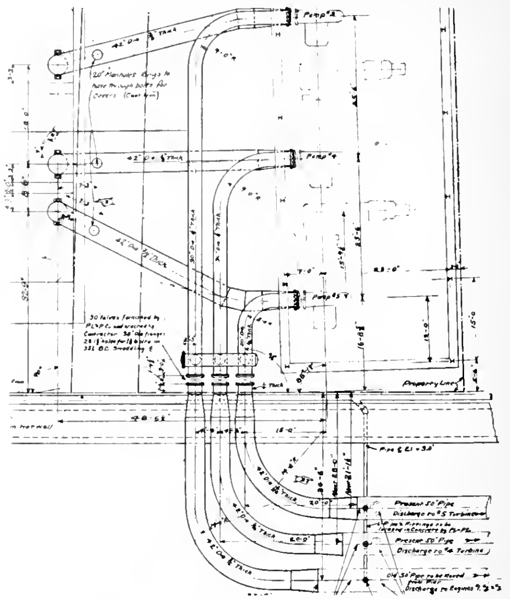
At this point the idea presented itself of using the whole circular area to advantage by building the outside walls of the pit in a circular form, thereby utilizing the arching effect of the concrete circle, and doing away with all of the heavy girders and reinforcing bars in them. The change was accordingly made and effected a great saving of time. Old concrete broken from other parts of the plant were imbedded in the thick segments of the walls between the circular exterior and rectangular interior. This construction was continued up to the + 17 level and from there the walls were extended 10 ft. higher as ordinary reinforced retaining walls, with a light 6 in. concrete fence surmounting the whole.

By this means all trouble with seaweed has been eliminated. The chambers are arranged so that one can be cleaned while the others are in operation.

The three 54 in. siphon pipes are made of ½ in. mild steel having a guaranteed tensile strength of 55,000 lb. per sq. in. After erection the pipe was subjected to a hydrostatic pressure of 30 lb. per sq. in. The siphon suction is started and maintained by means of three air compressors in the beach pump-house.



Siphon Air Pumps.


Circulating Water Pumps.

The water is drawn from the screen chamber and discharged to the condenser by three 30 in. Price double suction, centrifugal pumps each designed to deliver 24,000 gallons of sea-water against a total head of 40 ft. when operating at 225 r.p.m. and taking about 350 h.p. The pump inlet is 32 in., the discharge 30 in.

Circulating Water Pump House.

Each of these pumps is connected through a noiseless flexible coupling to a 16x27x18 in. special Harrisburg-Fleming side crank engines equipped with Gardner throttling governor with speeding attachment. With 18 lb. gauge pressure, 3 lb. back pressure and 100 to 150 degrees supeheat these engines are rated at 400 i.h.p. These engines were supplied by Chas. C. Moore & Co., engineers.

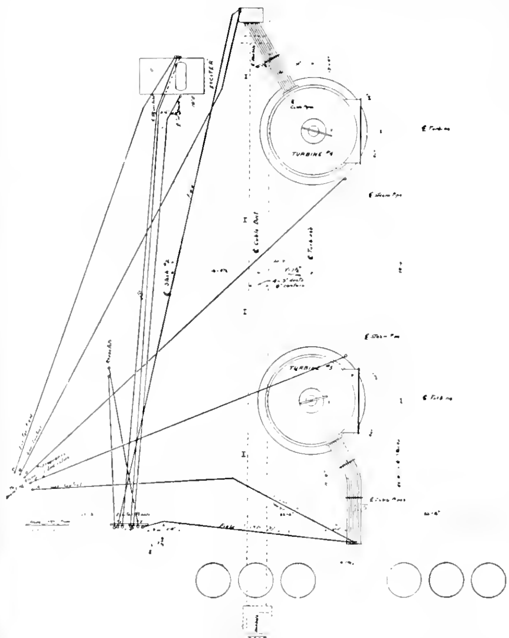
Switchboard.

The switchboard and high tension switching apparatus is contained in an enclosed gallery running the length of the building between the engine and the boiler room and partly extending over the latter. A look-out window commanding a view of the generator floor is placed in the center of this gallery. At the time of writing, the new switchboard had not been installed the original temporary wooden board still sufficing.

The new board being installed by the Westinghouse Electric & Manufacturing Company consists of twenty slate panels with benchboard control. These comprise five generator panels, ten feeder panels, four blanks and an auxiliary apparatus panel, with the usual instrument equipment.

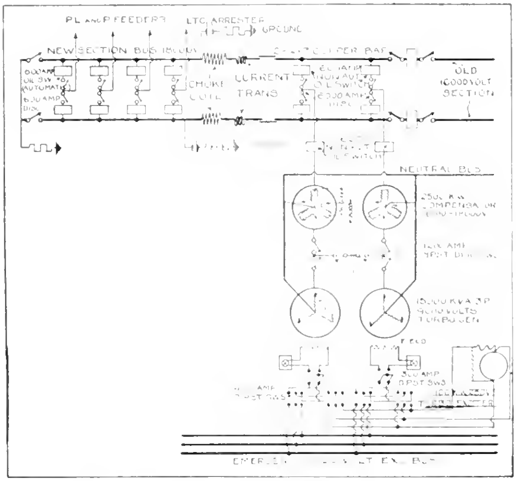
Connections.

The wiring connections are shown in the accompanying plan of generator connections and wiring diagram. Each generator feeds through ducts under the floor and a 1200 ampere disconnecting switch to its set of three compensators which raise the voltage from 9000 to 18,000, the neutral being grounded. After passing through 600 ampere oil switches the leads are connected to the bus bars through 600 am-

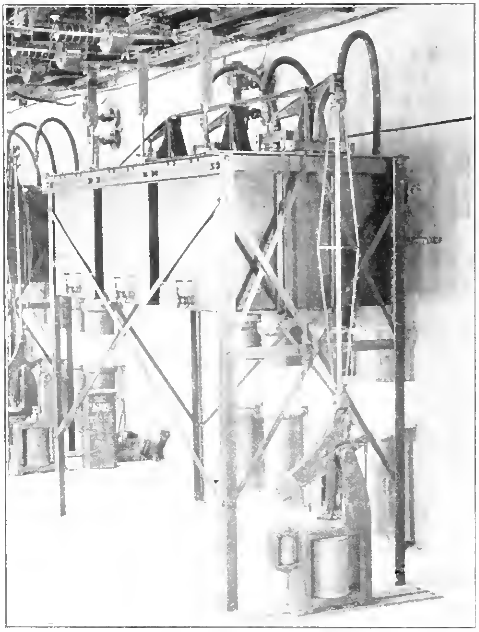


Plan of Generator Connections.

pere oil switches. The turbo-generator bus-bars are sectionalized from those of the reciprocating units by 1000 ampere switches. Thence through lightning arresters and another set of disconnecting oil switches the bus joins the 18,000 volt feeders.



Wiring Diagram.



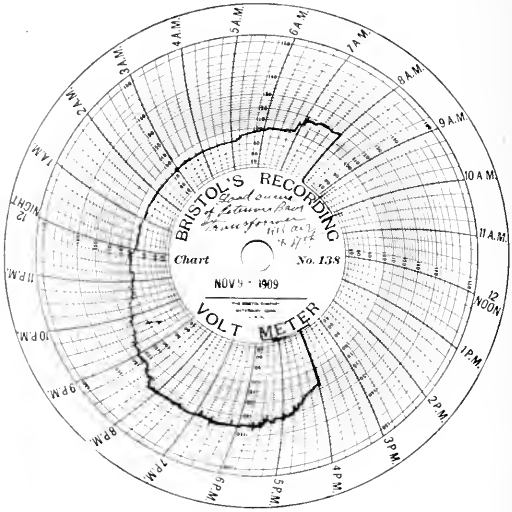
Kelman Oil Switches.

All the oil switches were manufactured by the Kelman Electric & Mfg. Co. of Los Angeles and are of the well known pantograph type previously described in these columns. They are arranged for remote and control and have given eminently satisfactory service.

A SIMPLE METHOD FOR DETERMINING THE LOAD ON A TRANSFORMER.

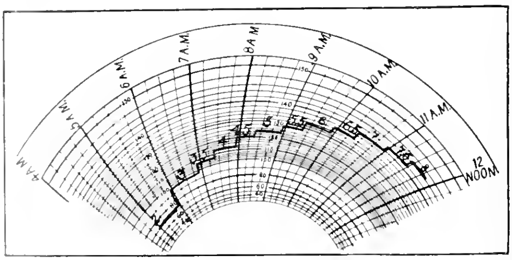
BY E. G. ROBINSON, JR.

The engineer of a small power plant is often confronted with the problem of accurately determining the load in a lighting transformer, the peak and its duration, whereas he cannot afford to buy the necessary measuring instruments. For this purpose the writer has successfully and satisfactorily employed a standard recording Bristol voltmeter and a spare transformer.



Transformer Load Curves.

The latter is a standard Westinghouse series transformer having a ratio of 20 to 5 amperes and intended for use on a 6600 volt switchboard. By connecting its 20 ampere coil in series with the primary of the transformer under test and connecting the terminals of the 5 ampere coil to the recording voltmeter, the results shown on the accompanying chart were obtained.



Calibration Curve.

To get the calibration curve a portable ammeter was connected in the primary circuit and the current varied over a wide enough range to cover all practical requirements.

The series transformer may be mounted in a box that can be hung on the cross-arm beside the transformer to be tested.

NOTES FROM PRESS REPORTS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION MEETING.

The 1912 N. E. L. A. meeting will be held at Seattle, Washington, during the first week in June, following the affiliation of the Northwest Electric Light & Power Association with the national body.

Grounding secondary alternating current circuits of 150 volts or less was unanimously advised by the committee on this matter. The American Institute of Electrical Engineers recommends grounding all circuits of 250 volts or less.

Gas producers, gas and oil engines give excellent satisfaction where carefully operated in small plants, especially with low grade fuel. For large plants the initial investment cost is heavier than that of steam-turbine equipment.

Protection against lightning on transmission lines may be afforded by arresters (preferably of the electrolytic type), an underhung insulator with a grounded portion between the line and the support, a superposed ground wire, and by grounding the neutral wire on primary and secondary distribution circuits.

The use of reactance coils to limti the current from short-circuited generators was strongly advised. They should be inserted in series with the armature of low reactance turbo-generators, a four per cent reactance effectually limiting the short-circuit current delivered to the bus to fifteen times full-load current.

The public policy committee recommended accident insurance, sickness insurance and death benefits, service annuities, profit sharing, employees' savings and investment funds, and life insurance as the best means of creating harmony between employees and companies. These recommendations were adopted by the association.

Ventilation of turbo-generators, according to a paper of R. B. Williamson of the Allis-Chalmers Co., requires from 5 to 7.5 cu. ft. of air per minute per k.v.a. output, the weight of air being even greater than that of the steam consumed by the turbine at the same time. The heat in the discharged air represents from 3 to 6 per cent of the station output which is available for preheating the air supply to the boiler or heating cold buildings. To supply this large amount of air calls for some sort of blower provided with dust-filtering devices.

An adjustable speed single phase motor, which fulfills every condition now met by the d.c. adjustable speed, was described by W. A. Layman of the Wagner Electric & Mfg. Co. With a motor rated at 3 h.p. six speeds are possible between 750 and 2250 r.p.m., giving from 2 to 5 h.p. respectively. This motor, like a new constant speed type also described, employs a rotor provided with a commutated winding and two sets of brushes, one in the axis of the main stator winding, the other normal thereto. One set carries the working currents, the other the compensating and exciting currents, speed regulation being provided through the stator windings. The motor is claimed to have a low percentage of slip at each step between no-load and full-load and to have a high power-factor under all operating conditions. In Europe this type has been commercially developed up to 15 h.p.

Water-wheel troubles discussed include unbalanced gates, pitting of turbine runners, horizontal shaft and gears for vertical units and nozzles for impulse wheels. Simplification in governor design is urged, one suggestion being for a governor electrically actuated by change in load rather than by change in speed, thus obtaining closer speed regulation.

In ice-making, under average conditions, the consumption of electric power should not exceed 60 kw. hours per ton. The load-factor in a latitude above that of New York is about 65 per cent and the maximum demand of a 100 kw. plant would be about 230 kw., which includes the power for operating compressors, all auxiliary apparatus and electric lights for the plant.

A 1½-ton electric truck in service 24½ days each month averaging 29½ miles daily requires an average of .491 kw.-hours per mile, .6 cent for oil and other supplies per mile, 1.4 cents per mile for general repairs, 1.62 cents per mile for tires, and .7 cents per mile for batteries, making a total of 7.32 cents per mile with current at 4 cents per kw. hour. This does not include the cost of driver or garage service.

Transmission line interruptions are more frequently due to failure of insulators than to any other cause on account of their lower factor of safety according to observations of M. Hebgen of Butte, Montana. For 100,000-volt lines he recommends a factor of safety of three, for 50,000 volts of four, and for 20,000 to 30,000 volts of five, because abnormal surges are relatively greater in lower than in the higher voltage lines.

The fuel cost of gasoline lighting with gasoline at 18 cents per gallon varies from ½ cent to 1 cent per hour with single mantle units, while at 10 cents per kilowatt-hour a 100-watt tungsten lamp costs 1 cent per hour. Adding the maintenance cost and fixed charges of a gasoline outfit, makes this lighting method even more expensive than that of tungsten lighting, in addition to the many other disadvantages and inconveniences of gasoline.

Electricity for the rural districts of Southern California is being energetically installed under the direction of S. M. Kennedy of the Southern California Edison Company. The highest standard of line construction is employed in extending lines, the average cost depending upon the voltage and the nature of the ground over which the extension is made and ranging from $600 to $1200 per mile. Extensions are made on the basis that 50 per cent of the cost of the line is represented by the first year's income. One 26-mile line was built on the understanding that one-third of the cost be borne by the consumer.

The advantages of oil fuel in the East, where the oil to produce a certain amount of steam costs one-third more than the coal, include its quick-firing capabilities in emergency, its lower banking cost and a saving in investment and labor for peak load. Experiments in simultaneous firing of coal and of oil, the former from the front and the latter from the rear of a partly partitioned furnace, show that 2000 kw. can be carried as easily as 1200 kw. when only coal is used. This means a gain of 66 per cent by the use of oil or the saving of 40 per cent in the cost of boiler equipment for a given output.

PRESENT STATE OF IRRIGATION DEVELOPMENT IN CALIFORNIA.[1]

BY FRANK ADAMS.

Eliminating projects still in the promotion stage, a conservative estimate shows 750,000 acres for which construction to provide irrigation water is now under way. Of this area, about one-third is in Southern California and the remainder north of Tehachapi.

Of the area now being brought under water in Southern California, the principal acreage is under the various mutual water company systems of Imperial Valley, the Yuma project of the United States Reclamation Service, the new municipal aqueduct being built to supply water for use within the city of Los Angeles, but which will irrigate a large area outside of the city pending the increased needs by the city, and the southern coastal regions where development has already reached a high state. In the latter sections it is the increase in pumping plants, notably around Pomona, Corona, Chino, Whittier, Covina, Anaheim, Fullerton, Riverside and San Jacinto Valley, that is increasing irrigation. At Redlands the most notable addition will come by the construction of a large multiple-arch dam in the San Bernardino mountains to supply water to the various mutual water companies that two years ago acquired the property of the Bear Valley Irrigation Company, from which they had theretofore been purchasing water but which they have now mutualized. In San Diego county the matter of chief interest from the standpoint of irrigation engineering is the raising by 15 ft. of the height of Sweetwater dam.

The rapid irrigation development now taking place in Southern California is the more surprising in view of the popular impression that all of the available water was long ago utilized in that section of the State. An account of it is submitted to show the great value attached to water there and the extreme efforts being put forth to acquire an increased supply.

Turning north of Tehachapi, in some sections development is not unlike that of the south. Pumping for water is being increasingly resorted to in the foothill sections of Kern, Fresno and Tulare counties, and one of the largest pumping irrigation systems in the west is now operating in San Joaquin county, the water supply being the San Joaquin river. The lower San Joaquin Valley is fortunate in having a plentiful supply of underground water of good quality and at relatively small distance below the ground surface. In the belt around Porterville, Lindsay, Exeter and Lemon Cove, Mr. V. M. Cone, of this office, finds it now considered profitable to pump against a head of 400 to 500 ft. for citrus trees. Outside of pumping, very little irrigation development is being accomplished in the lower San Joaquin Valley, owing to exhaustion of the low-water flow of the streams and the difficulties of utilizing flood waters that now go to waste for want of adequate water right laws under which they can be acquired. In the upper San Joaquin, a steady increase in the irrigated area is being brought about in Modesto and Turlock irrigation districts, and what is perhaps the most notable accomplishment in the entire San Joaquin valley is the recent successful organization of the Oakdale and South San Joaquin irrigation districts, in San Joaquin and Stanislaus counties. These two districts have jointly purchased for $650,000 the old Tulloch irrigation system at Oakdale, with its valuable water rights in Stanislaus river, and have together voted bonds to the extent of $3,475,000 for the construction of reservoirs, canals and distributaries. In Sacramento Valley, which has been more backward than any other part of the State in recognizing the needs and advantages of irrigation, the largest single unit is that of the Sacramento Valley Irrigation Company at Willows, which as the successor of the old Central irrigation district, formed under the the original Wright act, is constructing works to cover a large area of the valuable land of this valley. At Orland the Orland project of the United States Reclamation Service, covering 14,000 acres in its first unit, was 77 per cent completed October 1, 1910, and ready for settlement. Other areas of more or less size are also being put under irrigation and sold to settlers in Sacramento Valley. The opening of the Western Pacific Railway over the Sierra Nevada at a considerable distance north of any other transcontinental line has given new impetus to development, which must be largely through irrigation, in the northeastern counties of Plumas, Lassen and Modoc. In the latter county additional land is to be irrigated by the Klamath project of the Reclamation Service. Plans of the Reclamation Service for reclaiming and ultimately irrigating 27,000 acres of Klamath marsh and about an equal area of Tule lake, all in California, have already been approved by the Secretary of the Interior and bids for construction in connection with the latter were opened November 1, 1910. A third sub-project included in the plans of the Reclamation Service, but not yet approved, provides for the irrigation of 10,400 acres in California south and west of Clear Lake reservoir.

[1]Extract from report to Nathaniel Ellery, State Engineer of California.

EARNINGS AND TAXES OF ELECTRIC PROPERTIES.

California street railways have reported their earnings and taxes as follows:

	Earnings.	Taxes.
United Railroads, S. F.	$7,672,873.15	$306,914.92
Pacific Electric, L. A.	4,911,863.54	196,474.54
L. A. Ry. Corporation	4,600,748.11	184,029.92
Oakland Traction	2,934,508.54	117,380.34
Los Angeles Pacific	1,821,306.01	72,852.24
San Francisco, Oakland & San Jose	1,230,599.49	49,223.98
Los Angeles & Redondo	728,662.31	29,146.48
San Diego Electric	541,535.22	21,661.40
Northern Electric	528,703.95	21,148.16
Sacramento Electric, Gas & Railway	509,151.53	20,366.06
California Street Cable Road	374,249.56	14,969.98
Peninsula Railway	233,373.78	9,334.94
San Jose & Santa Clara County	208,038.26	8,321.52
San Bernardino Valley Traction	191,994.87	7,679.80
Geary Street, Park and Ocean	188,892.33	7,555.68
S. F., Vallejo & Napa	172,403.21	6,896.12

The gas, electric and power companies which will be called on to pay more than $10,000 taxes each follow:

	Operative Receipts.	Taxes.
Pac. Gas & Electric	$12,836,732.96	$513,469.32
L. A. Gas & Electric	3,314,199.76	132,568.00
Southern California Edison	3,294,750.78	131,790.04
Pac. Light & Power	1,970,008.00	78,800.32
Great Western Power	930,176.99	37,207.08
City Electric, S. F.	912,792.44	36,511.70
San Joaquin Light & Power	789,351.18	31,574.04
Western States Gas & Electric	740,386.67	29,615.46
San Diego Con. Gas. & Electric	543,260.15	21,730.40
Northern Calif. Power Co. Con.	530,028.99	21,201.16
Metropolitan Light & Power, S. F.	411,480.10	16,459.20
Sierra & S. F. Power	397,191.85	15,887.68
Mt. Whitney Power & Electric	328,690.77	13,147.64
Southern California Gas	256,137.16	10,245.08

POWER FACTORS.[1]

BY F. D. NEWBURG.

Incandescent lighting with small lowering transformers.—Power-factor, 90 per cent to 95 per cent.

Alternating-current inclosed-arc lamps with constant-current transformers.—Power-factor, from 60 per cent to 75 per cent, depending upon whether the transformers are carrying their rated number of lamps. An average figure would be 70 per cent.

Direct-current metallic-arc lamps with rectifiers.—Power-factor, from 55 per cent to 70 per cent, depending upon whether the rectifiers are carrying their rated number of lamps. An average figure would be 65 per cent.

Single-phase induction motor, squirrel-cage rotor, 1/20 h.p. to 1 h.p.—Power-factor, 55 per cent to 75 per cent, average 68 per cent, at rated load.

Single-phase induction motors, squirrel-cage rotor, 1 h.p. to 10 h.p.—Power-factor, 75 per cent to 86 per cent, average 82 per cent, at rated load.

Polyphase induction motors, squirrel-cage rotor, 1 hp. to 10 h.p.—Power-factor, 75 per cent to 91 per cent, average 85 per cent, at rated load.

Polyphase induction motors, squirrel-cage rotor, 10 h.p. to 50 h.p.—Power-factor, 85 per cent to 92 per cent, average 89 per cent, at rated load.

Polyphase induction motors, phase-wound rotors, 5 h.p. to 20 h.p.—Power-factor, 80 per cent to 89 per cent, average 86 per cent, at rated load.

Polyphase induction motors, phase-wound rotors, 20 h.p. to 100 h.p.—Power-factor, 82 per cent to 90 per cent, average 87 per cent, at rated load.

Induction motor loads in general.—Power-factor, from 60 per cent to 85 per cent, depending on whether motors are carrying their rated loads.

Rotary converters, compound wound.—Power-factor, at full load can be adjusted to practically 100 per cent. At light loads it will be lagging, and at overloads slightly leading.

Rotary converters, shunt wound.—The power-factor can be adjusted to any desired value, and will be fairly constant at all loads with the same field rheostat adjustment. Rotary converters, however, should not be operated below 95 per cent power-factor leading or lagging at full load or overload.

Small heating apparatus.—This load has the same characteristics as an incandescent-lighting load. The power-factor of the load unit is practically unity, but the distributing transformers will lower it to some extent.

Arc furnaces.—Power-factor, 80 per cent to 90 per cent.

Induction furnaces.—Power-factor, 60 per cent to 70 per cent.

Electric-welding transformers.—Power-factor, 50 per cent to 70 per cent.

Synchronous motors.—Adjustment between practically zero power-factor leading to zero power-factor lagging.

Operating power-factors above 95 per cent will be obtained only when practically all of the load is synchronous motors or converters which may be operated at practically unity power-factor.

[1] Extract from Paper Presented at New York Meeting National Electric Light Association.

PHYSIOLOGICAL EFFECTS OF ELECTRIC SHOCK.

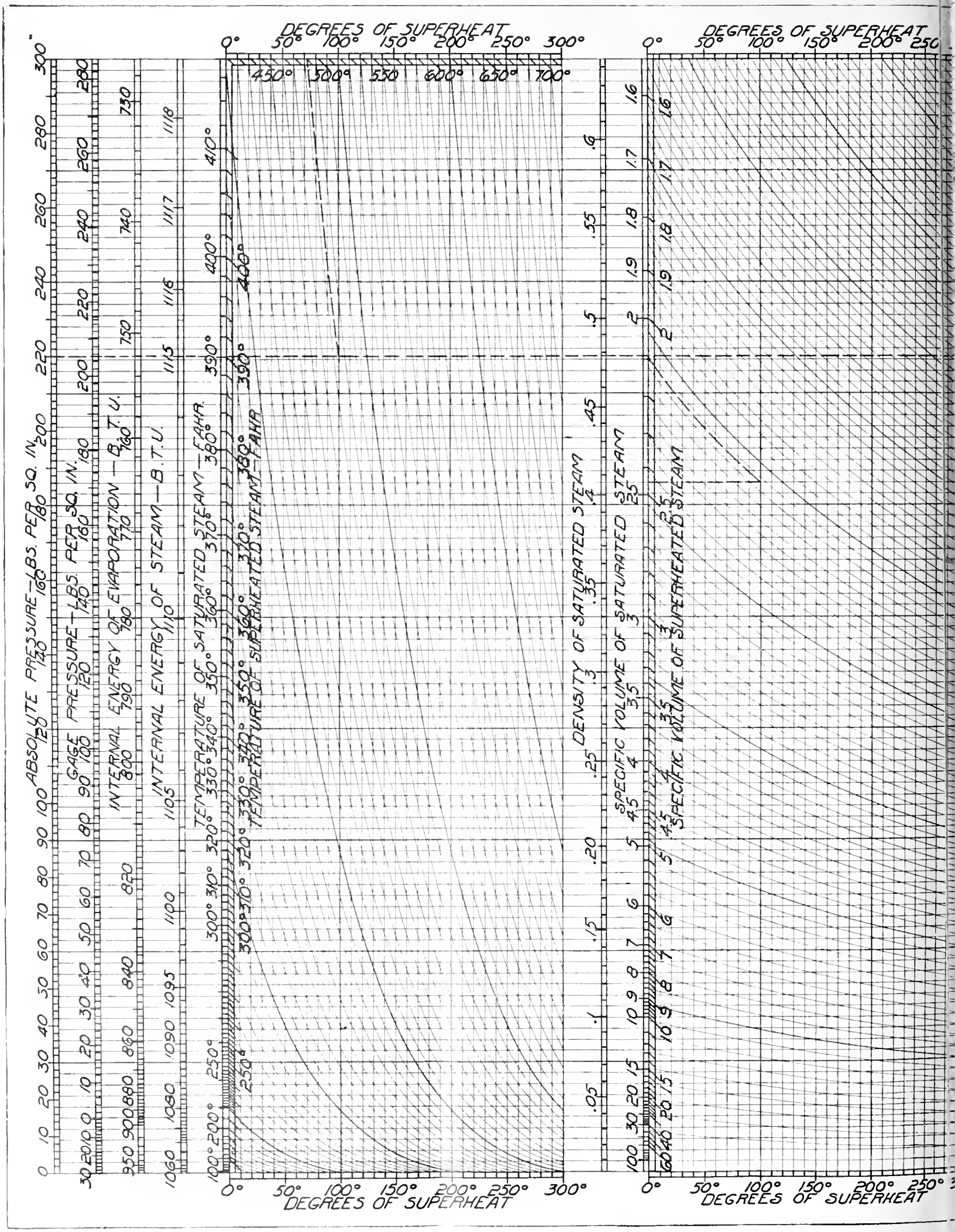
According to Doctors Krida and Stanton in the New York State Journal of Medicine the chief causes of death from electric shock are undoubtedly "fibrillary" contractions of the heart and respiratory paralysis. By the former are meant incoordinate contractions of the individual muscles of the heart, resulting in complete derangement of its normal rhythmic beat. Respiratory paralysis seems to be identical with the results of an overdose of an anaesthetic. Respiration may continue, and consciousness be preserved, in cases of fibrillary contractions, till anaemia of the nervous system causes death, but, if the action of the heart be unimpaired, respiration can frequently be artificially restored. As yet there is no known reliable means of restoring the normal action of the heart once it is deranged; on the other hand, if the respiratory organs are alone affected, prolonged artificial respiration enables a considerable percentage of recoveries from apparent death.

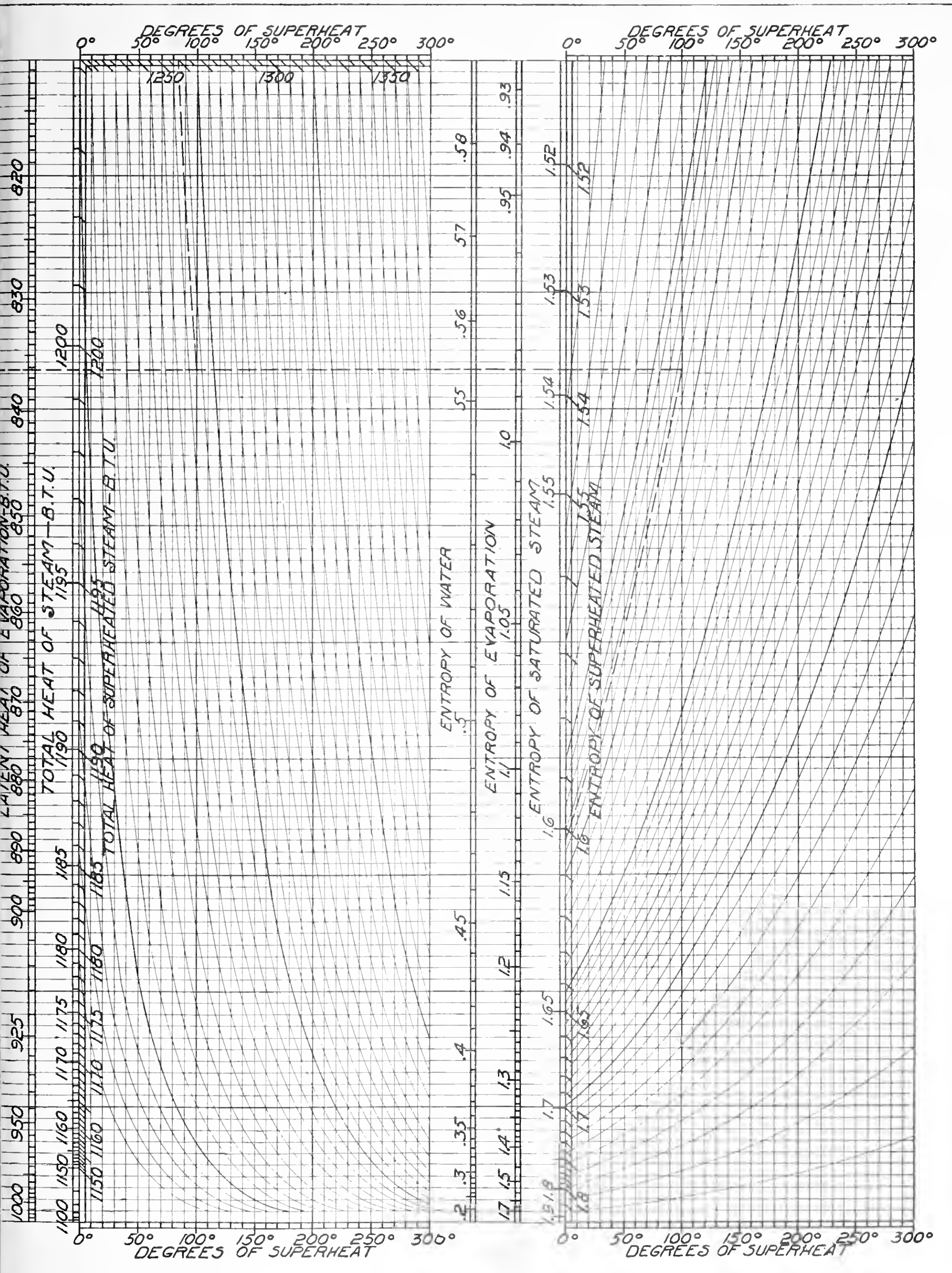
The conflicting results reached by many investigators, as to the physiological effects of electric currents, are chiefly attributable to the different forms of current employed and the diverse experimental conditions. The following remarks apply to cases of shock from circuits carrying amounts of energy such as are used in ordinary commercial work. The current passing through the body of the victim probably varies between ½ and 10 or more amperes.

The effects produced by direct and alternating currents vary directly with the current strength (and hence with the applied voltage), with the duration of contact and with the path of current flow through the body. The frequency of alternating currents is of great importance, low-frequency currents being usually more dangerous than high-frequency currents of the same strength.

Paralysis of the heart is especially liable to result from low-pressure currents, particularly if the heart be in the path of current flow; respiratory paralysis, however, usually follows on anaesthesia of the central nervous system set up by high-pressure currents. Actual destruction of tissues by burning occurs only at the site of high-resistance contacts, and is of minor importance as a cause of death: nevertheless the tissues often slough far beyond the apparent limits of the burn. In cases of accidental shock, the body often serves merely to complete the path of a high-pressure arc.

In general the lower animals are more susceptible than human beings to electric shock. Whereas 70 volts d.c. is often fatal to dogs, 100 volts scarcely affects a normal man, 200-400 volts produces muscular cramp, and 550 volts produces almost instantaneous respiratory failure. Low-pressure a.c. shocks are liable to cause fibrillary contractions; 600 volts causes fibrillations and respiratory paralysis, but 2300-4800 volts usually affects respiration alone (in such cases artificial respiration should be persevered with, for hours if necessary). The medical reports of the U.S.A. electrocutions since 1890 show that a few seconds flow of 2 to 7 amperes (at 1500 volts, 15 to 50 cycles per sec.) may not cause death, but with an application of 45 to 50 seconds' duration, the heart's action is permanently suspended.


DEGREES OF SUPERHEAT
ABSOLUTE PRESSURE—LBS. PER SQ. IN.
GAGE PRESSURE—LBS. PER SQ. IN.
INTERNAL ENERGY OF EVAPORATION—B.T.U.
INTERNAL ENERGY OF STEAM—B.T.U.
TEMPERATURE OF SATURATED STEAM—FAHR.
TEMPERATURE OF SUPERHEATED STEAM—FAHR.
DENSITY OF SATURATED STEAM
SPECIFIC VOLUME OF SATURATED STEAM
SPECIFIC VOLUME OF SUPERHEATED STEAM
DEGREES OF SUPERHEAT



GRAPHIC REPRESENTATION OF THE PROPERTIES OF SATURATED AND SUPERHEATED STEAM.

Based upon data from Marks and Davis's Steam Tables.

This chart gives the approximate numerical value and shows the relations existing between the various properties. The dotted line clearly indicates the method to use.

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Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
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Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas." Weekly.

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CONTENTS

Grounding Secondaries

The wisdom of grounding secondary circuits is generally conceded and the question now resolves itself into selecting a limit, whether 250 volts, as recommended by the A. I. E. E., or 150 as urged by the N. E. L. A. The prime intent of this practice is to protect such circuits from destructive high tension current flow, due either to a break-down of transformer windings or to accidental contact between primary and secondary wires outside the transformer, lightning and line discharges being merely contributory danger sources.

The principal objection to a limiting circuit potential of over 150 volts is the possibility of shock from contact between a live part of the circuit and any ground, as a water pipe or bath tub. When a ground wire is run from a transformer secondary such an accidental connection is necessarily a short circuit. A 250 volt shock is not considered fatal, but at best is a disagreeable experience and may cause a fall or serious fright. Fatalities at this voltage are usually due to a weak heart or other secondary cause. With a potential difference of over 120 volts the benefits of grounding may be had without these disadvantages, but voltages up to 250 on lighting circuits are coming more and more into use and the dangers to be prevented by grounding are just as great and in some cases greater as higher primary potentials become more common.

Failure to provide ground wires of sufficient carrying capacity and good ground contact are responsible for much of the dissatisfaction with this means of safety. While strong, ample and permanent connections are easily made at reasonable cost, a suitable ground contact requires special study for each case.

Besides the possibility of actual break-down, the condenser action of isolated secondary transformer windings places a heavy strain on the insulation throughout a distribution system, especially with the increasing use of higher voltages over wider areas. Cases have been cited where the static potential between the secondary winding and ground, due to the condenser action, may become as great as the impressed potential of the high tension circuit. Increased insulation in the transformer is of little value in preventing destructive results, while a ground connection offers immediate relief. The importance of the lowest possible resistance in the ground circuit is readily apparent.

The question of the danger in grounding circuits of over 150 volts is not altered in any way by greater care in making ground connections, in fact the possibility of accidental shock is enhanced, so that the determination of a limiting voltage becomes a question of expediency. Both engineers and operators agree that grounding at some fixed limiting voltage should be mandatory. The former naturally considers the question from the standpoint of absolute protection of lighting circuits and assumes that of the two possible evils the greater or more probable must be considered at all costs. The operator, on the other hand, takes a more conservative stand, forming his judgment, not so much from theoretical considerations as from the experience with troubles of this

sort, never forgetting what he has perhaps suffered from damage suits, possibly unjust from his point of view, but vital nevertheless to his serenity of mind and method of operation. It is to be hoped that this all important question may be discussed and understood so thoroughly by all concerned that it may be settled by fixing rules which will be agreeable to all.

Prolonging Pole Life

Hardwood poles are almost unknown in the Pacific States where soft woods may be secured easily and cheaply from local supply, although not always economically desirable because of their short life due to dry-rot. After many years of experimentation, the use of pole timber from the Northwestern States has become almost universal. Probably the most enduring wood for the purpose is California redwood, but it must be sawn and its high cost makes its use prohibitive in competition with Washington fir.

The life of this timber, if placed in the ground untreated, varies greatly with soil conditions but at best is seldom over six years, when, if the center of the wood is still sound, the dry-rot must be cut away for a distance of 18 inches above and below the ground line. Some means must then be adopted to strengthen and reinforce the pole. This invariable short-coming in wood poles has produced the two characteristic effects always created when a radical improvement becomes necessary, namely, prevention or substitution,—prevention by covering or impregnating the pole with preservative compounds, and substitution by employing steel or concrete steel towers.

The possibility of cheaply and effectively impregnating the wood with creosote or other preservative compound is unquestioned, and lack of proper equipment, careless work, or unfamiliarity with correct methods, are the probable causes of the unsatisfactory results sometimes obtained. Where the poles have been bought by contract with an impregnating specification the work can easily suffer fraudulent fulfillment with little danger of detection.

Assuming that the life of wood poles may be indefinitely prolonged, this form of line construction will long maintain its place in electrical systems. Aside from cheapness, the fact that dry wood does not form a good ground connection from the insulators is one of the principal arguments in favor of its use. This feature is reported to be somewhat lessened in its effectiveness by impregnation with creosote under pressure, when the pole acts as if thoroughly wet and has more or less conductivity.

The substitution of reinforced concrete poles for wood has been the object of considerable experimentation. Though they are undesirable because of their conductivity, they have long life, great strength and clean appearance. Weight and cost argue against their general adoption except for special services which justify the use of more expensive and stronger forms of line construction.

Steel towers are not so much substitutes as improvements over wood poles, where the highest service requirement is necessary, where conductors must be carried at extreme heights, in mountainous districts, or where there are unusual wind strains, the tower then being the only method of maintaining a transmission system. Where these extreme requirements are not met, the problem may easily become one of careful computation as to which form of construction should be adopted. This is clearly the case in a transmission line of reasonable length and medium electromotive force, where the wood pole line, perhaps in duplicate, has considerable advantage in first cost over a double tower line with a double circuit. The cost of maintenance and the nature of the load will probably determine the selection. Preservative treatment is especially important in the innumerable cases where it is only the low cost of wood poles which makes a project commercially feasible.

Artificial Cooling of Generators

The subject of cooling electrical generating and converting apparatus in large units has become a matter of such great importance that, where not so long ago it was considered necessary to design machinery so as to be self cooling, the other extreme of elaborate artificial means of carrying away the heat produced by electrical losses is now proposed. For many years transformers have been cooled by extraneous means, so that refinements in the methods of cooling and in the subsequent design of apparatus are not especially novel. The advent of the turbo-generator, with its high speed and necessarily compact design, brought about several systems of forced air ventilation whose development have necessarily kept pace with the constant tendency toward increased output from single units. This influence is also being felt in the construction of the slower speed machines which have heretofore been designed for self cooling.

The fact that many of the largest engine or water wheel type generators have failed to carry loads in accordance with the purchaser's specifications until forced ventilation was tried indicated the possibility of a design including some such form of cooling. Large turbo-generators are found to require a greater weight of air for cooling than of steam for driving during the same interval. This air represents a direct loss, not only in the heat which it removes but also in the power necessary to supply it. As to what dependence should be placed on forced ventilation in the design of generators is yet a matter of conjecture. The ideal machine should have a minimum of accessories and to add artificial cooling as a necessity is an obnoxious idea to the operator whose greatest respect for a generator has been based on its ability to carry rated loads within the temperature limit.

A reasonable and conservative design is probably reached in a type of machine operating at 450 r.p.m. or thereabouts, where air is driven through the stator laminations and windings under the influence of fan blades permanently affixed to each side of the rotor, direction being given to the air currents by end bells mounted on the stator so that the final discharge parallels the shaft in both directions. This is self contained, requires no ducts and instead of mixing the air into an endless variety of currents from the motion of the rotor gives it a uniform direction and ventilating action.

PERSONALS.

George R. Alexander, assistant engineer of the Northern Electric Railway, has returned to Chico from San Francisco.

John J. Connell, consulting electrical engineer, has returned to Los Angeles after spending a few days at San Francisco.

R. Leo Vander Naillen, electrical engineer for the Oro Light & Power Company of Oroville, was at San Francisco during the past week.

C. W. Hinchcliffe, general manager of the Consolidated Telephone, Telegraph & Electric Company of Tucson, Ariz., is a San Francisco visitor.

G. B. Bush, general commercial superintendent of the Pacific Telephone and Telegraph Company, recently sailed for Japan on a vacation trip.

D. W. Cole, the engineer in charge of the government construction work on the Truckee-Carson project, was at San Francisco during the past week.

Leon M. Hall returned to San Francisco during the past week after making a trip through Nevada in connection with an electrical engineering investigation.

Frederick Whorf, who has been chief electrician of the State's Ferry Depot Building, at San Francisco since it was first opened, has been succeeded by Charles Stanton.

E. C. Bradley, vice-president and general manager of the Pacific Telephone and Telegraph Company, returned to his San Francisco office last Wednesday after an Eastern trip.

R. S. Porter, the new vice-president of the California Section of National Association of Stationary Engineers, has returned to Santa Barbara after attending the annual convention at San Francisco.

E. M. Capps, the city engineer of San Diego, is at San Francisco with a party of city officials, investigating the subject of State harbor improvements having a bearing upon the proposed bond issue.

John Coffee Hays, general manager of the Mt. Whitney Power Company, spent the past week at San Francisco and on last Thursday attended the funeral of his father, John C. Hays, a prominent pioneer, who died June 13th.

J. Q. Brown, chief engineer and purchasing agent of the Oakland Traction Company, recently visited New York after ordering twenty-five new 70-foot electric coaches for the Key Route electric railway system of the United Properties Company.

Elam Miller, commercial engineer, A. H. Griswold, plant engineer, and A. C. Stannard, traffic engineer, of the Pacific Telephone and Telegraph Company, have returned to San Francisco after making an inspection of the system in Oregon and Washington.

A. Phillip an official of the Poulsen Wireless Telegraph & Telephone Company, with headquarters at Copenhagen, spent last Monday at the San Francisco branch of the company on business connected with the extension of the wireless telegraph service.

W. D. Ward, of the Pelton Water Wheel Company's sales force, has returned to San Francisco from Montana, where he closed a contract with the Libby Water Works Company for Pelton-Francis turbine equipment for an electric generating unit, which is to be installed near Lewiston.

C. B. Zabriskie, one of the officials of the United Properties Company, and New York representative of the Key Route and Oakland Traction system arrived at the San Francisco office of the corporation last week to confer on the important extension work that is being undertaken.

David Brian, who has charge of the electric power plant in the Hamburger Building at Los Angeles, has returned to that city after attending the State Convention of the National Association of Stationary Engineers at San Francisco, and being elected president of the organization for California.

Mortimer Fleishhacker, of the City Electric Company, returned to San Francisco last Saturday from New York where he completed arrangements for the purchase of his corporation by the Great Western Power Company. It can be authoritatively stated that after July 1, Mortimer Fleishhacker and Herbert Fleishhacker will be made vice-presidents of the Great Western Power Company and will have the control of its affairs. They have reorganized the financing of the company, which now has very strong backing, both American and English capital being represented.

TRADE NOTES.

The John Wood Company, handling electric weld products, have opened an office and salesroom at 219-221 Pacific Building, San Francisco, Cal.

The John G. Sutton Company has been awarded the contract for all of the electrical work on the new city hall in Oakland, the figure being $40,000.

The Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., has just received an order from the Great Western Power Company, San Francisco, Cal., which calls for six 300 k.v.a. oil insulated, self-cooling transformers.

The Kellogg Switchboard & Supply Company is installing a complete telephone system covering the buildings and extensive grounds of the new hotel that has been opened in the Yellowstone National Park in Montana, by the Hotel Association.

Recent transformer business secured by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., includes an order from the Desert Power & Water Company, of Kingman, Arizona, for four 600 k.v.a. oil insulated water cooled transformers.

The California Electrical Construction Company have taken a $5000 contract for wiring the country mansion of W. S. Tevis near Bakersfield. Charles Sefton and Dan Bronson have gone south to take charge of the work, which will require about three months to complete.

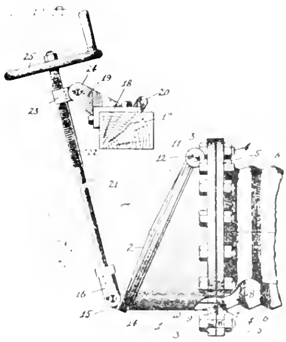
The Great Western Power Company has awarded a contract to the Pelton Water Wheel Company of San Francisco, for two impulse-wheel units for driving General Electric generators in connection with an electric installation, which is to be used in the construction of the large impounding dam at Big Meadows. The total capacity of the two wheels is 1500 h.p. Pelton oil pressure governors will be used.

On June 1st 1911, The Sprague Electric Company was merged with The General Electric Company, of Schenectady, N. Y. Its business will be conducted under the name Sprague Electric Works of General Electric Company. The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Company will be continued by the Sprague Electric Works of General Electric Company under the same organization, with Mr. D. C. Durland in responsible charge as general manager.

The Union Iron Works Company of San Francisco have purchased the good-will, patterns, records, etc., of the Risdon Iron Works. The United States Steel Corporation recently purchased the site and plant of the Risdon Iron Works, but did not take over any of the equipment, and through its acquisition by the Union Iron Works Co. the latter has added materially to its position as a large manufacturer of mining machinery, etc. R. H. Postlethwaite, formerly manager of the Risdon Iron Works, will superintend the department created by this consolidation.

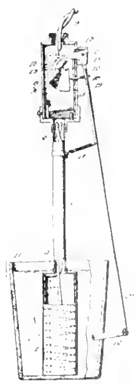
PATENTS

994,347. Head-Gate. Karl Johan Thorsby, Oakland, Cal., assignor to California Corrugated Culvert Company, Oakland, Cal. In a head-gate, the combination of a pipe section forming the gate carrier, said pipe section having a flange at its rear end; a gate hinged to said pipe section and adapted to



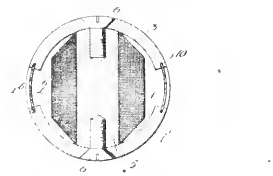
seat against its forward end; a conduit pipe; an independent flange conforming to and encircling the conduit pipe, the said pipe having its end bent over the face of the independent flange; and bolts clamping the flange of the pipe section and the independent flange of the pipe conduit together.

994,351. Safety Device for Immersion-Heaters. Charles S. Walton, Los Angeles, Cal. In combination with an electric immersion heater comprising a heating element, electric supply connections therefor, a switch carried by the device and



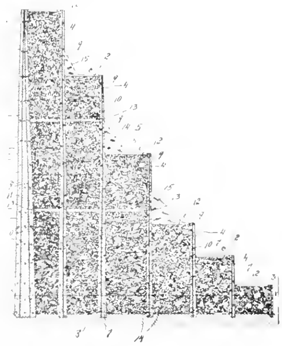
controlling said supply connections, and controlling means for said switch adapted and arranged for engagement with the wall of the receptacle in which the heater is to be immersed to hold the switch in closed position, and means tending to move the switch to open position.

994,303. Armature. Stanley A. Duvall, San Francisco, Cal. An armature for dynamo-electric machines comprising a core member, segmental pole pieces at each end of the core member, disks of non-magnetic material secured to each end of the pole pieces, a coil surrounding the core member and occupying the space between the core member and the pole pieces and disks, and segmental closure members of non-magnetic material closing the space between the ends of the pole pieces and the end disks, said segmental pole pieces hav-



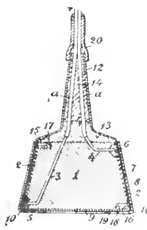
ing longitudinal slots in their edges and said end disks having segmental slots and said closure members engaging and fitting in the said slots in the pole pieces and end disks.

994,666. Dam Construction. George J. Bancroft, Denver, Colo. A dam consisting of a number of rows of cells or chambers, the walls of which are thickest at the base of the dam



and gradually decreasing in size toward the top, and a suitable filling contained within the said cells or chambers to form a solid mass of the dam, substantially as described.

994,128. Electric Heating Unit. Edward J. Ovington, Los Angeles, Cal., assignor, by direct and mesne assignments, to Electric Device Company. An electrical immersion heater comprising a water-proof heat-conducting shell of smaller vertical than horizontal extension, a non-heat-absorbing core,

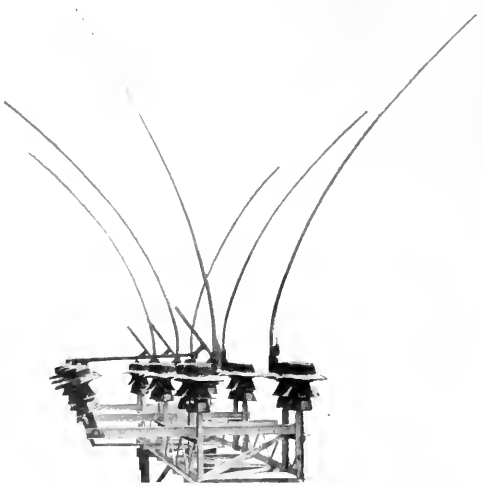


electrical resistance around the core, heat-conducting electrical insulation between the resistance and the shell, a cap in the end of the shell, said shell being spun over the cap and the joint being water-proof, a handle fastened to the shell, and electrical leads extending through the handle and connected with the terminals of the resistance.

INDUSTRIAL

BOWIE HIGH TENSION SWITCH.

The present trend of the best practice in high tension construction is to locate as much apparatus as possible in the open, thus saving all the expense of buildings, and outlets, and reducing considerably the cost of wiring. Among other reasons why this is desirable is the fact that it minimizes any possible damage likely to be caused by accident. The photograph shown herewith illustrates an outdoor high tension switch built for the Hydro Electric Company of Bodie, Cal., by The Bowie Switch Company of San Francisco, Cal. The switch is mounted on a galvanized framework, set in turn on two wooden poles. The framework, which is strong and rigid, is shipped riveted together, thus minimizing the labor of erection.



Bowie High Tension Switch.

The switch is operated by a vertical shaft, which in turn operates a rock shaft carrying the insulators which work the blades. The operating mechanism is simple, and effective, and requires little power, as it has a toggle action at both the start and end of the stroke. As the operating shaft rotates through slightly over 180 degrees, it locks the switch in either position, open or closed.

This switch serves a double purpose, acting both as a circuit breaker for opening under load, and also as a positive disconnecting switch. The advantage of combining these two functions in a single switch is greatly appreciated by operators, and effects a material saving in installation, taking the place of two, and often of three switches.

The advantage of immediate inspection at all times is an important consideration. It is desirable to be able to see positively that the lines are open.

The switch is practically indestructible as all parts except the insulators are made of metal, and all the steel is galvanized. Although these switches have been in practical use in many parts of the United States and Canada for the past seven years, under the most severe climatic conditions, it is claimed that they have not yet failed to open the circuit promptly, and in an entirely satisfactory manner, causing no surging on the lnes.

THE TYPE DI AIR-COOLED CHOKE COILS.

It is sometimes convenient to mount choke coils on ceilings so that the insulating coil supports hang pendent and at other times it is preferable to arrange them so that the coil rests on the supports, as shown in Fig. 1. The new Westinghouse DI Coil can be mounted either way, because the insulating columns can be removed and inverted by taking out four bolts.

An aluminum rod, bent into a helix of about 15 inches diameter and containing about 30 turns, forms the coil proper. Bracing clamps are provided to give mechanical strength to

Type DI air cooled choke coil arranged for upright mounting.

the helix. The aluminum rod used is of sufficient diameter to safely carry 200 amperes.

Each coil is supported on two insulating columns made up of porcelain insulators, which, except for the end pieces, are interchangeable. The number of insulators used in any column depends on the voltage of the circuit in which the coil is to be used.

Type DI coils can be mounted in any position convenient for the wiring, on floor, wall or ceiling. For floor mounting, the parts are arranged as illustrated, and for inverted mounting the insulator columns are inverted and the base attached to the ceiling. The insulating columns are supported on substantial cast iron blocks fixed on wooden bases.

These choke coils are intended principally for the protection of transformers and should not be used for generators. Where greater reactance than is afforded by a single coil is desired for the higher voltage circuits, it is recommended that two or more coils be connected in series.

ALLIS-CHALMERS LIGHTING TRANSFORMERS.

The general design of lighting transformers has been well established for many years, but occasionally marked improvements in details have been made which have greatly increased the practical value of this type of electrical apparatus. The new line of lighting transformers which Allis-Chalmers Company is now placing on the market, brings out this point very fully, as radical departures have been made from older designs. These changes have produced a transformer in which the heat is conducted to the air from the coils in a much more rapid manner than is usually the case, thus insuring a transformer with an exceedingly low temperature rise. The greatest visible change in these transformers is a provision, in the larger sizes, of three cooling surfaces instead of the single surface in the ordinary plain case transformer. This is accomplished by encircling the main case with a jacket and providing for the circulation of oil between the two. Both the tank and the jacket are made of boiler plate. They are connected at top and bottom by short tubes leaving an air space between the two. All joints are welded, making both the tank and jacket seamless, and absolutely preventing the chance of leakage. In addition to the three radiating surfaces provided, the space between the jacket and the tank forms a flue which causes currents of air to ascend at a considerable velocity, thereby exerting a scrubbing action on the surface which greatly facilitates heat dissipation. This style of tank is used on all lighting transformers from 20 k.v.a. to 50 k.v.a., inclusive. The tubes connecting the top and bottom of the tank and jacket provide for a continuous and positive circulation of the oil. Tests made on these show that this circulation is rapid and that heat is quickly conducted from the transformer through the oil to the surface of the tank and jacket and thence to the air.

An entirely new departure has also been made in the 40 k.v.a. and 50 k.v.a. sizes by so arranging the coils that there is a ventilating space between them which allows full and free circulation of the oil. These sizes are wound with two low voltage and one high voltage coil, the latter being placed between the other two. The coils are separated from each other and the space between them provides ventilating ducts on each side of the high voltage coil through which the oil can readily circulate. This ventilating feature helps to make a transformer that is extremely cool in operation.

All these transformers are supplied with the 5 per cent and 10 per cent taps which have long distinguished Allis-Chalmers transformers from others. These taps or leads are connected near each end of the primary winding and enable normal secondary voltage to be secured, even if the voltage supplied the primary coil is 5 or 10 per cent below normal. These transformers are designed for use on 2200 volt or 1100 volt lines. The use of the taps makes it possible to step down from 2200 volts in nine different ratios and from 1100 volts in six different ratios. Allis-Chalmers Company claims that these many special and useful features give a transformer having extremely satisfactory operating characteristics and one which is unexcelled for central station work.

A NEW SOLDER IN PASTE FORM.

Do you remember, when you were a youngster at home, watching the plumber, tinsmith or electrician heating his soldering iron in a portable furnace and mending the leaks in the pipes, wires or kitchen utensils by melting his solder through contact with the hot iron and soldering stick? And do you recall how he poured on a little acid to form a flux and kept on heating his iron and repeating the process?

You probably observed him with a great deal of interest and curiosity and thought his work picturesque and mysterious; but it was mighty troublesome and a precious waste of time, labor and materials to the workman. At that time such laborious methods were necessary in order to solder efficiently.

Recently a new kind of solder has been placed on the market. It is in the form of a paste in a collapsible tube, put up just like the familiar tube of tooth paste, and all that is necessary for its effective use is to scrape off the surface of the part a little with a knife, squeeze some of the soldering paste on and apply a match, candle or torch. When the paste becomes hot it fuses and solders in the same manner as the old style soldering stick.

The name of this new device is Solderall, and it s being marketed by the H. W. Johns-Manville Company, through their branch houses in various cities throughout the country. While this article has been in use only a short time it has met with practically universal approval by the trade and the public. Its convenience, cleanliness, economy and many other advantages have naturally made a wide appeal to householders as well as to plumbers, tinsmiths, electricians, hardware and supply stores and others.

NEW CATALOGUES.

Bulletin No. 9, from the Benjamin Electric Manufacturing Company, is an illustrated price list of the various Benjamin street lighting fixtures for high and low voltage circuits.

Bulletin No. 1080 from the Western Electric Company, entitled "Railroad Telephone and Selective Apparatus," lists all varieties of apparatus used in this new field of telephony.

The Aylesworth Agencies Co. of San Francisco have issued a Pacific Coast Wireless Telegraph Directory, comprising a complete list of all navy, commercial and experimental stations in Washington, Oregon and California including all ships and stations on the Pacific.

General Catalog No. 40 from the Chain Belt Company of Milwaukee, Wis., is a substantially bound 278 page volume illustrating and describing their complete line of elevating and conveying machinery. Special attention has been paid to the dimensional and engineering data.

Allis-Chalmers Company have issued Bulletin No. 1523 entitled Portable and Stationary Air Compressors for Industrial Purposes. This bulletin gives a general description and photographs of this type of apparatus, together with tables containing data relative to sizes, capacities, weights, etc.

The General Electric Company has just issued Bulletin No. 4831, describing briefly a type of oil switch suitable for installing in manholes. These switches are made single, double or tripe pole, single throw, and are for use on circuits on voltages up to 7500. The normal current rating is 200 amperes.

The General Electric Company recently issued Bulletin No. 4825, which illustrates and describes a line of compact, accurate and moderate priced instruments for use on alternating and direct current switchboards. The bulletin contains dimension diagrams and also illustrations showing the actual size of the meter scales.

Westinghouse Engine Driven Direct-current Interpole Generators—Type Q. Circular 1194, is the title of a new publication recently issued by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. The circular is well illustrated and contains valuable information on the advantages of interpole construction and this entirely new line of standard direct-current generators, which has just been put on the market.

The General Electric Company has just issued Bulletin No. 4819, which is devoted to the subject of alternating current switchboard panels, suitable for general use in the central station and isolated plant. The bulletin contains information including dimension and connection diagrams regarding three-phase generator panels, single circuit and double circuit three-phase feeder panels, generator voltage regulator panels and combination regulator and exciter panels and three-phase induction motor panels.

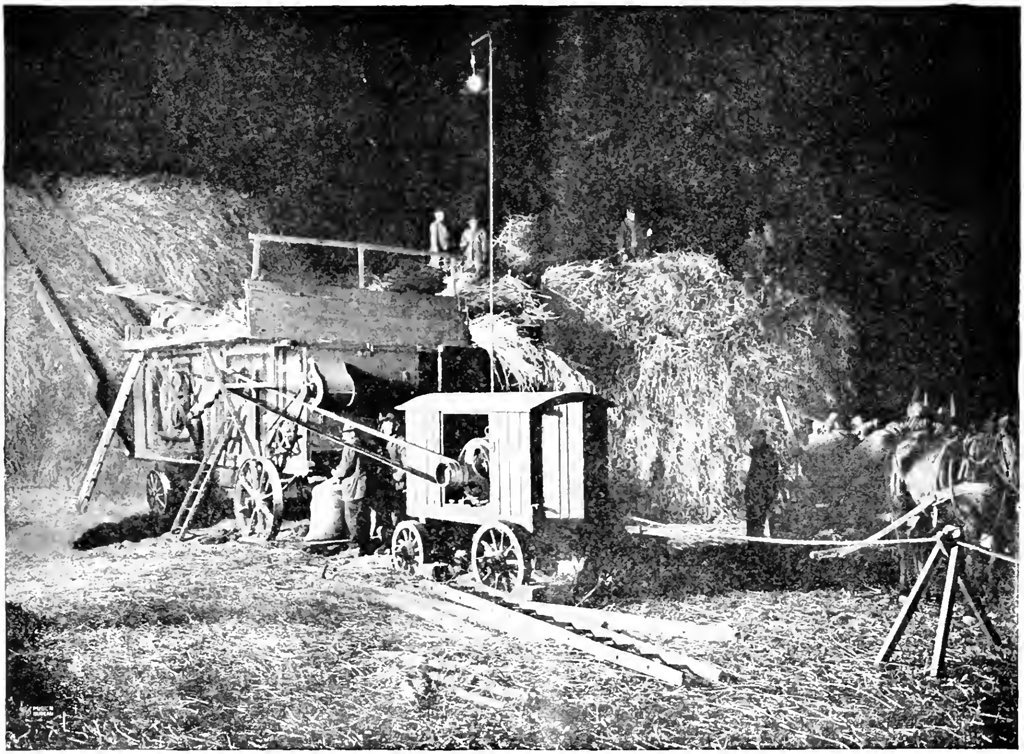
ELECTRICITY ON THE FARM.

The practical farmer must be convinced of the economic value of electricity for farm work before he will consider the expense involved in its adoption. A bulletin recently issued by the General Electric Company gives examples not only of the theoretical value of electricity for this service, but as actual demonstrations of what has successfully been accomplished along this line.

The extent to which electricity should be adopted will vary with the different conditions on each farm. On some of the farms which have been electrically equipped, the electric current is used only for lighting and for driving auxiliary machinery by means of motors, while other farms have been completely equipped with electric appliances for field work, farm building machinery and household use.

If we compare electricity with other forms of applied power for farm work, we find that its chief advantages are reliability, safety, cleanliness and flexibility in application. This latter quality has a peculiar value in equipping farm buildings with motor drive, since due to the scattered location of the buildings on the average farm, the cost of equipping the various buildings with individual engines (except in special cases) is practically prohibitive. On a farm supplied with electric current every building may be provided with motor drive and the power transmitted from the feeder lines by means of wires which can be easily run, and can if necessary be conducted underground so as to avoid any interference with the operations in the yards. It is instructive to note that in practically every case where electricity has been adopted the original equipment has been added to as the farmer became convinced of its practical utility, convenience and economy.

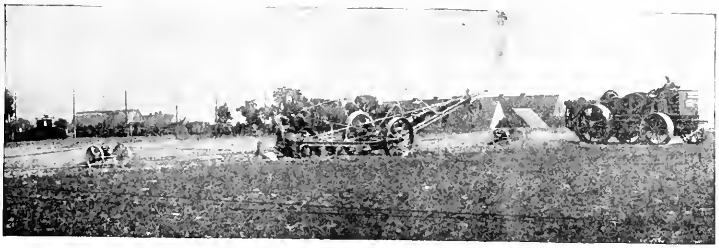
The electric motor can be readily applied to all classes of farm and dairy machinery. The sizes of motors usually required are light in weight and can therefore be installed without special foundations. They may be mounted on the machine itself or on the floor, wall or ceiling, and drive by means of belts or gears; or, for some classes of machinery they may be direct connected to the driving shaft. The adoption of electric drive does not involve any radical change in existing machinery, and even the hand operated machines may be driven by small motors by simply substituting a pulley for the handwheel or crank.



Threshing at Night by Aid of Electric Motor and Electric Arc.

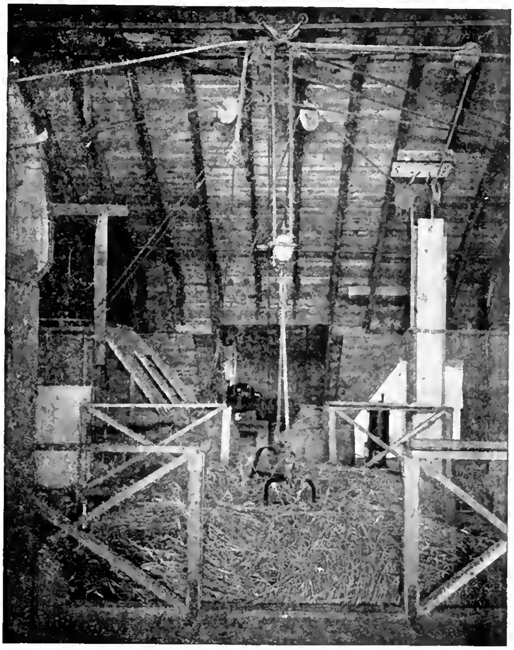
In order to reduce the first cost of the motor equipment it has been the practice in some instances to provide a portable motor, which can be moved from building to building, and belt connected to the various machines, or transported to the field for the operation of threshers, loaders and other machinery. In this latter case it is of course necessary to run wires to the point at which the motor will operate; these wires can be carried on a reel, unwound as the motor is taken into the field and rewound upon its return.

The motor-operated hay hoist is a good example of the saving in labor which may be obtained by the use of motor drive in barns, as well as the safety with which electric motors may be installed and operated in proximity to combustible materials. This hoist is operated by a 10 h.p. motor which drives it through gears, and a simple drum controller is used to regulate the hoisting and traveling speeds. This hoist has been installed and operated with entire success for a period



An Electric Plow.

Electrically Driven Ensilage Cutter.



Electric Hay Hoist.

Electrically Driven Hay Wagon.

of more than three years; the method of operation being as follows: The load of hay is driven in onto the main floor of the barn and stopped under an opening to the loft, located in the center of the building. Two U-shaped forks are inserted in the hay by the driver and the hoist is started by a man in the loft and the entire load elevated thereto, the motor controller being so placed near the loft opening as to give the operator an uninterrupted view. The hoist pulley is then automatically tripped, and the load of hay thereby transfered to an overhead rail, along which it is pulled by the hoist to the position selected for it in the loft. The forks are next released by pulling two light tripping ropes and the hay is deposited on the loft floor, the hoist tackle returning for the next load. The entire operation is carried on by two men and a ton of hay can be lifted from the wagon and stored at either end of the 280 ft. loft in less than five minutes.

Electric drive is equally adaptable to the operation of hay presses, feed grinders, root choppers, corn shellers, huskers and ensilage cutters. In the latter application a portable motor is generally used and drives the ensilage cutter and silo filler through belting.

A simple portable motor outfit consists of a motor and controller mounted on a wooden framework which can be easily dragged or carried to the point at which it is desired to operate the motor. When motors are required for operating field machinery at some distance from the source of power, a more eloborate portable outfit is used. It ordinarily consists of a small covered truck with broad wheels in which the motor, controller and cable reel are enclosed. This type of portable motor outfit can be readily equipped with arc or incandescent lamps so that operations in the fields can be effectively carried on at night. An outfit of this kind is equally adaptable for operating a thresher, ensilage cutter, milling machinery, or for intermittent irrigation pumping. A portable field outfit can often be profitably used during harvesting operations, as it will, in the case of emergency, enable the field work to be carried on both day and night without interruption.

The Butte Engineering & Electric Company has been awarded the electric wiring contract on the Lincoln School of San Francisco for $1767.

NEWS NOTES

FINANCIAL.

SAN FRANCISCO, CAL.—Ernest Thalmann, the New York banker, Patrick Calhoun and their associates have completed arrangements for the sale of $1,000,000 of the bonds of the Sierra and San Francisco Power Company to complete its electric power generating plant on the Stanislaus River, together with its distributing system. This company was acquired some time ago to give the United Railroads an independent and assured source of power for the operation of its street-car lines in this city. It is the intention to sell the surplus power in the markets of this city and the interior.

SAN FRANCISCO, CAL.—The report of the United Railroads for April and the first four months of the year shows that the company continues to make gains in earnings over the corresponding periods of last year. Only gross receipts are reported. The company this year will probably carry 160,000,000 paying passengers as against 150,000,000 in 1910. This, added to the traffic usually handled by the Geary, Union and California street roads, the three independent lines, will probably show by the end of this year 215,000,000 fares paid on San Francisco's street railways. In April the United Railroads earned gross $652,866, an increase of $4851 over the same month of the preceding year. For January, February, March and April the gross earnings aggregated $2,525,935, as against $2,484,866 for the same period of 1910. This is an increase of $31,069. In April of this year the paying passengers totaled 13,057,320, an increase of 97,000 over April of 1910. For the first four months of this year 50,518,700 passengers were handled. This is an increase of 621,380 over the first four months of 1910.

INCORPORATIONS.

LOS ANGELES, CAL.—The Los Angeles & San Fernando Electric Railroad Company; capital stock, $25,000; subscribed $25,000. Directors: L. C. Brand, E. T. Earl, W. G. Kerchoff, J. F. Sartori, Harry Chandler.

LEWISTON, IDAHO.—Articles of incorporation have been filed with the Secretary of State for the Boise-Council-Ladrene Railroad. Preliminary surveys have already been made for the line which is to be an electric road from Council through the fruit belt of Adams County and the mining and timber regions of the Seven Devils sections. The incorporators are: E. W. Rowman, C. M. Hail, D. S. Manville, Harry C. Wyman and George H. Bener. The capital stock is $2,000,000.

ILLUMINATION.

SACRAMENTO, CAL.—Proposals for the installation of electroliers for Sacramento are being received.

PASO ROBLES, CAL.—The Paso Robles Light and Power Company has purschased the electrical supply store of Arthur C. Bryan.

GOLDENDALE, WASH.—It is the intention of the Northwestern Electric Company to install a 5,000 h.p. plant in the first unit on the Klickitat river.

OAKLAND, ORE.—An election to be held here to determine a bond in the sum of $15,000 to defray the expenses of an electric plant and pumping plant.

CONCONULLY WASH.—This city is to have an electric light plant and water works according to a decision made by the city council. Both plants are to cost $10,000.

RIVERSIDE, CAL.—The City Council have passed a resolution for installing electric poles, conduits and lamps on each side of Twelfth street, from Main to Pepper streets.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company has secured contract for furnishing this city with power for the pumping station and for street lights.

RATON, N. M.—City Engineer Martin is now figuring on the Park lighting system. Plans call for fourteen or fifteen 100 watt tungstens, set on cement supports at various points in the park.

LOS ANGELES, CAL.—The Board of Supervisors has sold a franchise to the Southern California Gas Company for laying gas mains along the roads highways in country district for $100. This takes place of blanket franchise asked by Gas Company and refused by Supervisors.

SAN LUIS OBISPO, CAL.—Attorney Charles P. Kaetzel will apply for a franchise and right of way for the Santa Maria Gas Company at the head of which is E. A. Easton. It is the intention of the new company to run a pipe line from the seat of operations at Santa Maria to Guadalupe, Nipomo, Arroyo Grande and thence to San Luis Obispo.

SUSANVILLE, CAL.—The Board of Town Trustees has considered the application for franchise of the Northern California Telephone Company and the Lassen Electric Company. The franchises were granted with the understanding that all poles hereafter erected must conform to the provisions of the ordinance, and be placed so the wires will be 35 feet above the ground .

SACRAMENTO, CAL.—The contract for lighting the State Capitol building and park has been awarded to the Great Western Power Company, the bid being 1⅞ cents per kilowatt-hour. The contract is for three years and includes light and power for the Capitol and grounds, and will begin July 1st. Onamental electroliers are to be placed in Capitol Park, and underground conduits are to take the place of overhead wiring. The State is now paying 5 cents per kilowatt for power in its printing office. The new contract will also apply there.

TRANSMISSION.

KLAMATH FALLS, ORE.—J. L. Hammersley, publicity and right of way man for the Rogue River Electric Company says that the Rogue River Electric Company contemplates entering the Klamath country with its power lines.

VICTORIA, B. C.—Bids addressed to W. L. Conlson will be received up to the 26th of June for the construction work in development of hydro-electric power on the Puntledge River, Comex, B. C., for Canadian Colleries; the construction of dams, flume, pipe line and power house.

DEE, ORE.—J. P. Newell, a Portland civil engineer, has been in this locality for several days surveying for parties who contemplate utilizing the power at the junction of the east and west forks of Hood River at Winan's station on the Mt. Hood Railway. A dam 100 ft. high is contemplated.

OROVILLE, CAL.—Arrangements are being made by the Great Western Power Company to start a thousand men at work within the coming month upon the excavation for the dam to be erected at Big Meadows. For this work there is now on hand $1,800,000 for immediate expenditure. Within the past few days the company has taken an option until July 1st upon all the lands in Big Meadows, with the exception of a couple of ranches in the upper end.

LOS BANOS, CAL.—E. B. Walthall, assistant to the general manager of the San Joaquin Light & Power Company of Fresno, has been in town, conferring with Ralph W. Merritt, vice-president of the Miller & Lux corporation, regarding the site for a substation of the power company.

TRANSPORTATION.

BERKELEY, CAL.—The amended franchise sought by the Oakland Traction Company for the right to change its tracks on Grove street in South Berkeley, has been granted by the City Council of Berkeley.

LEAVENWORTH, WASH.—L. W. Pratt, J. B. Askew and W. M. Harvey have made application to the County Commissioners of Chehalis County to operate an electric railway on the streets of Leavenworth.

SAN FRANCISCO, CAL.—Permission to the United Railroads to construct a loop at the terminal at Forty-ninth avenue and B street has been granted by the Board of Public Works, the object being to facilitate the moving of cars.

SAN LUIS OBISPO, CAL.—Walter Gould Lincoln who has a franchise pending before the City Council has filed a petition asking the Board of Supervisors for an electric railway franchise throughout the county of San Luis Obispo.

BISHOP, CAL.—The Owens River Valley Electric Railway Company has arranged for 14 acres of ground at the southeastern edge of town. A tract 530 feet on Main street and 900 feet deep has been reserved for the company buildings and for a yard.

FRESNO, CAL.—Frank W. Webster, manager of the Fresno Traction Company, has accepted an offer to superintend the reconstruction of the Bakersfield street car line of the San Jaoquin Light & Power Company. Mr. Webster rebuilt the Stockton car system a couple of years ago. Last year he was appointed manager at Fresno and rebuilt the Fresno system.

FRESNO, CAL.—Grading on the Fresno, Hanford & Summit Lake Railroad is now within a mile of Sanger. The grading crews will soon be brought to the junction of Jensen avenue and the Lone Star road and started on their march toward Fresno. Between 15 and 16 miles of road have now been graded. The grading has been completed between Fowler and Sanger, and about five miles of the grading has been done between Fowler and Kinsburg.

MARTINEZ, CAL.—The State Railroad Commission has ordered the officials of the Santa Fe Company to meet with the heads of the new Oakland, Antioch and Eastern Electric Railway and agree as to a rate for freight and passenger transportation between the two lines. The order of the Commission follows the complaint of farmers and residents of central Contra Cost county that the Santa Fe refused to make a traffic agreement with the officers of the electric line.

SACRAMENTO, CAL.—F. V. Keesling of San Francisco president of the Sacramento-Folsom Electric road, has applied to the City Trustees for a franchise on the city streets. The road is to run from here to Folsom with a side line into Fair Oaks. The company is capitalized at $1,000,000. It is believed the company's purpose is to aid in the development of the Natomas Colony project of 35,000 acres across which it was built. The Natomas Consolidated, capitalized by W. P. Hammon and others for $20,000,000, is said to be largely interested in the road, it being owner of the colonization project and other undertakings in the Sacramento valley. The road will carry freight and passengers. The franchise asked from the city is to construct the line from 31st and Y streets on 31st north to I, thence west on I to 2nd, thence south on 2d to M street, to the M-street bridge across the Sacramento River, running part of the way over the Northern Electric tracks.

OAKLAND, CAL.—A temporary restraining order prohibiting the Oakland City Council from granting a franchise along Shatter avenue to the Oakland and Bay Shore Railway has been issued by Superior Judge Waste on petition of Joseph A. Hoffman, a property owner whose lands front on the proposed right of way, and who appears for a number of residents along that thoroughfare. The grounds alleged in Hoffman's petition against granting the franchise are that the route described in the petition signed by property owners is different than the route described in the ordinance granting the franchise.

BERKELEY, CAL.—The Berkeley line of the Southern Pacific Company will be the next in the interurban service between the Alameda county cities and San Francisco to be electrified. Work of preparing the local line for the change was started this week when a force of men began laying feed cables along the new poles which have been erected along the Shattuck avenue line for some time. After the feed lines are completed, the work of stringing trolley wires will be started. Following the completion of work on Shattuck avenue, the crews will be put to work completing the wiring of the Ashby-Ellsworth street line, on which service will be opened as soon as arrangements are completed.

TELEPHONE AND TELEGRAPH.

CHELAN, WASH.—The Knapp's Coulee Telephone Company proposes the construction of a telephone line from Knapp's Coulee to this place.

SNOHOMISH, WASH.—A number of telephone and other wires owned by the Snohomish Light & Power Company here suffered complete destruction in the recent conflagration; loss about $1,000.

WALLACE, IDAHO.—Geo. R. Bloomer, manager of the North Idaho Telephone Company, announces plans for the immediate construction of a telephone line between Murray and Nelson, a distance of 14 miles.

EUREKA, CAL.—G. A. Webb of Crescent City, secretary of the Del Norte People's Tel. Company, which gave Eureka and Crescent City direct telephone communication for the first time, has sent notice of a stockholders' meeting to interested parties in this city. H. L. Ricks of this city, one of the stockholders in the independent telephone line, states that for some time past negotiations have been pending with the Pacific Telegraph & Telephone Company for the sale of the system to the great corporation and he is of the opinion that the deal will be consummated at the meeting of stockholders just called.

SAN FRANCISCO, CAL.—Announcement is made that the Postal Telegraph Company is to enter the telephone field. As the result of experiments just completed between Salt Lake City, Utah, and Reno, Nev.; between Reno and San Francisco its trunk telegraph lines are to be used for telephone messages between those cities. When the telephone experiments were made the wires were being used for the transmission of telegraphic messages between Chicago and San Francisco. Furthermore, four operators were at work, two in each direction, but at the same time men in Salt Lake and San Francisco were in conversation with Reno, talking through the telegraphic messages. A new power plant is being completed at Reno. When it comes into use through telephone service over the 800 miles of wire between Salt Lake and San Francisco will be established. In the former city local service will be offered even before that time with automatic instruments. This service will be put in along the line to the west and north to Billings and Great Falls, Mont.

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JOURNAL OF ELECTRICITY
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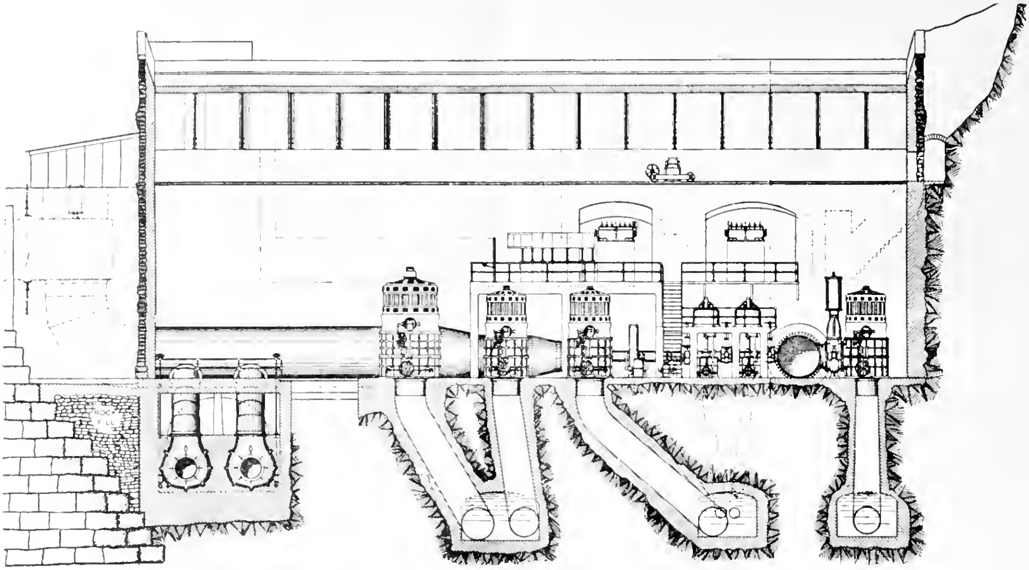
POWER AT THE ROOSEVELT DAM

BY HARRY WELCH.

The Salt River Valley Project adjacent to Phoenix, Arizona, conserves the flood waters of two streams, so as to irrigate 240,000 acres of land from a 28-mile lake impounded by the Roosevelt dam. This arch gravity structure of rubble masonry rises 284 feet from foundations sunk 30 feet in the bedrock of the river. At base the dam is 168 feet through, tapering to a width of 20 feet at the top where the length, including the two bridges crossing the spillways, totals 1080 feet, 326,000 cubic yards of masonry and over 350,000 barrels of cement were necessary in the construction.

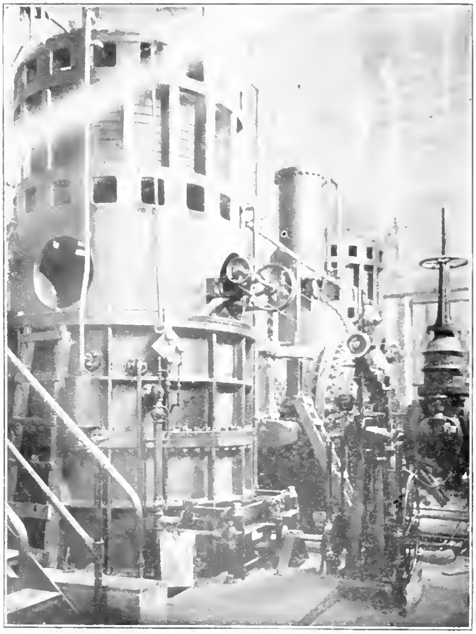
Roosevelt Dam

Among the first problems, was where to get the power to lift the giant blocks of stone into place, to make and grind the cement, to run the drills, and in fact to build the dam. Nineteen miles above the dam-site a weir across the Salt River diverted to a power canal 250 second feet of water under a 226



Section of Roosevelt Power House.

ft. head, through an inclined penstock tunnel, concrete and steel lined, to the three 1200 kw. vertical turbines. These operate at 500 r.p.m. furnishing three-phase, 25 cycle, 2300 volt current. Thence it was discharged into the river and allowed to continue



Vertical Turbo-Generators at Roosevelt Power House.

down stream. Here is generated the power that has built the dam and is now lighting the city of Phoenix, 75 miles away. The power is also used for street railways and commercial purposes at Phoenix as well as at Mesa, Tempe, and other Salt River Valley towns. The power generated at the dam is about 7200 kw., including three units to be operated under the reservoir head and in the entire project there will be generated when all the plans are completed, a total of about 27,000 h.p. At present the city of Phoenix consumes only about 2000 h.p., but power is transmitted to several points for pumping. At Sacaton, on the

Switching Station near Mesa, Salt River Valley.

Pima Indian Reservation, some fine batteries of wells have been established and power can here be used to lift water, for 10,000 acres of land. A number of

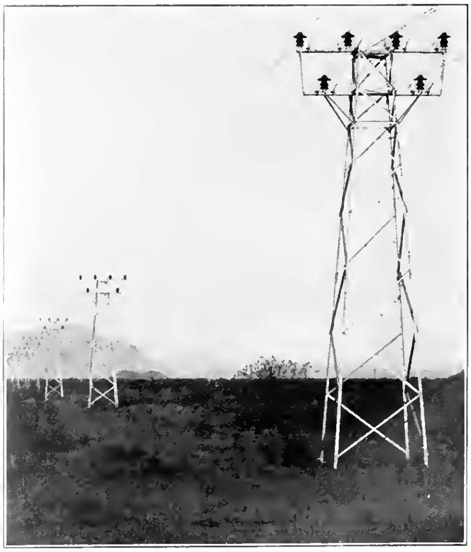
Sub-Station No. 2 and Well No. 8, Gila Indian Reservation, near Phoenix, Ariz.

motors are lifting water for 20,000 to 40,000 acres of land in the vicinity of Mesa, where are other large wells. In other points pumps can be installed to lower the ground water and lift drainage water to higher levels that cannot be placed under gravity ditches.

The journey of the water from the Roosevelt dam to its final distribution on the land is a story of utility. The stream passes from one power canal to another. Some of these power canals and tunnels are yet to be developed but all are included in the complete project, which is now fast acquiring the finishing touches. Seven miles from the Roosevelt dam the water will enter a short tunnel which will save 7000 feet of canal and at the same time develop 3500 h.p. The water returns to the old river bed and is uninterrupted for about twenty miles when it is directed through another tunnel 3500 ft. long, where it develops 2500 h.p. before re-entering the river below. Almost at once it is again taken up and is now carried along the rocky hillsides for several miles and then dropped a sheer 100 ft. through another set of wheels which will develop about 5000 h.p. The water then follows the river bed until reaching the Granite Reef Dam where it is diverted by a great weir, 1100 ft. long and 38 ft. high, to the main irrigating canals on the north and south banks of the river.

Portion of Concrete Lined Power Canal at Roosevelt.

In the main canals more power will be developed. On the south side of the river, two miles from the head of the canal, one-half of the water is turned into the Consolidated canal with a drop of 30 ft. and developing about 2000 h.p. in the fall. On the north side, the main canal, the Arizona, flows without interruption for fifteen or twenty miles, to a point at which about one-half of the supply will be diverted through a new crosscut canal. This canal carries the water about four miles along the base of the rocky points to a place where there will be a drop of 126 ft., the water in the fall developing 3000 to 5000 h.p. according to the season. The other half of the water of the Arizona canal, when it reaches the Arizona falls, a mile or two away from the dividing point, will develop about 700 h.p. On the south side of the river there is again a further possibility of developing another 700 additional h.p. The power generated will



Transmission Line Crossing Desert Near Salt River Valley, Arizona.

be sold to the ranchers in the valley at reasonable rates. Community lines from the main power lines to different sections will be established. It will be economical to operate the farm machinery with the cheap power available and there will be great quantities used for pumping in the sections of the valley that are outside of the 240,000 acres that are included in the project.

The great transmission line from Roosevelt dam to the city of Phoenix, seventy-five miles long, over mountain and desert, is splendidly equipped as are also the different power stations, pumping stations and batteries of wells. The transmission voltage is 45,000, the wires being arranged to form an equilateral triangle with 4 ft. sides.

It will be readily seen that with the great power possibilities of the project, there is in store for the farmer under this system of reclamation, a large revenue which will surely in time not only cover all annual charges for maintenance of the system, but in addition will pay him a handsome return, each year, for the money he has invested in his land. The entire scheme is inseparably associated with the ownership of the lands, and all the 240,000 acres of land that are included in the Salt River Project have a share in the concern, each acre a share and each share an acre. The Government has expended about $9,000,000 on the project to date and of this amount about $3,500,000 has been expended on the building of the Roosevelt dam. Comparing the dam with some of the famous dams built in the east it will be found that the structure at Roosevelt stores twelve times more water than the New Croton, Wachusett and Askokan reservoirs combined, while the cost of these combined reservoirs was seven times the cost of the main work in the Salt River Project. The first stone was laid on September 20, 1906, and the last stone was put in place on February 5, 1911.

The Salt River Project will not be turned over to the Water Users' Association for two years and in the meantime the Water Users' Association is arranging for the construction of the Crosscut canal, and has voted bonds for $900,000 for the purpose. The machinery has been ordered, several contracts have been let, and funds are well in hand. The Water Users' Association is the organization through which the Government deals with the farmer. Its membership is composed of the farmers and landowners whose lands are included in the project. The Government will not deal direct with the individual, but will deal only through the association. The value of the power features of the Salt River Project have been variously estimated, figuring the total horsepower at 27,000 and allowing $50 for a horsepower per year, we have a total of $1,350,000 or a net return of over $5.00 to each acre each year. Several offers have been made to the Water Users' Association for the taking over of the power features of the project but the association will develop and hold the great possibilities that are held forth in this unique scheme of reclamation and conservation. This association of farmers and landowners becomes a significant factor in the "power producing world" and undoubtedly the progress in the Salt River Valley under this system will be watched with great interest by people all over the country.

A REPLY TO COLONEL THEODORE ROOSEVELT.[1]

BY FRANK H. SHORT.

The Commonwealth Club of San Francisco, on March 27, 1911, tendered a banquet to Colonel Roosevelt. At this banquet I was invited to speak for ten minutes on "Conservation from the Point of View of the Western States." Colonel Roosevelt, as the guest of the evening, was, of course, allowed unlimited time, following all of the others. So far as the other gentlemen who spoke were concerned, he simply took sufficient time to "ditto" their remarks, and proceeded for the remainder of a full hour, in a very brilliant speech, to mutilate and obliterate my feeble remarks.

Colonel Roosevelt's reply to this argument, thus briefly outlined, was certainly brilliant, forceful and effective. We may always differ as to deduction and conclusion, but I very briefly propose to show that not only in his conclusions and his deductions, but in his statements Colonel Roosevelt, unwittingly, no doubt, preserved his consistency by being uniformly and always wrong.

It requires a philosopher to be right on general subjects, a statesman to be generally right on questions of government, but it requires a genius to be generally wrong on most subjects and still to be able to persuade people that he is right. Colonel Roosevelt is a genius.

First, I had referred to a decision of the Supreme Court of the United States, rendered some seventy-five or eighty years ago, and this decision was both seriously and jocularly assailed by Colonel Roosevelt as necessarily obsolete, entirely too ancient for modern use, and a subject fit only for jests and gibes, adroitly overlooking that portion of my remarks in which I had stated, "These decisions have been re-affirmed," etc., and have been held "to apply to the later admitted States and the lands and resources therein." All that had been decided in the first case, and all that I contended for was re-affirmed by the Supreme Court of the United States in the case of Kansas vs. Colorado, decided May 13, 1907; by the way, during the administration of President Roosevelt, and it certainly will be admitted that anything that occurred during his administration is strictly modern, not ancient and obsolete. In the case referred to, the Supreme Court of the United States used this language:

> "While arid lands are to be found mainly if not only in the western and newer States, yet the powers of the National Government within the limits of those States are the same (no greater and no less) than those within the limits of the original thirteen," etc.

The decisions of the Supreme Court of the United States related to certain property being held in trust and to certain powers of government fixed and delegated under the Constitution. Later inventions and changes in methods of commerce and mechanical devices do not transfer property, nor do they grant or extend powers, except to extend them in so far as a change in practice and custom may automatically result in bringing certain industries under a different governmental authority. Such later changes, inven-

[1]Abstracted.

tions and devices have no more to do with powers of government, and have no more connection with the rights of property, than has the invention of the aeroplane the effect of repealing the Ten Commandments.

If it is now argued that because of a change in condition and the development of values and uses not known, that a right of property held in trust, and a right of government fixed by an unamended law, is to be swept aside merely because one individual thinks it would be better for the great mass of mankind to take from the one and bestow upon the other, we cannot know but ere long we will be confronted with the argument that the Commandment "Thou shalt not steal," should be repealed, or more appropriately speaking, should be ignored, because to take from the abundance of the few for the benefit of a sufficiently large number of people (usually voters) is not stealing, but benevolent assimilation.

If conversion of trust property is commendable under a higher law, and for a greater good, who can say that it is not merely another and easy step to a repeal of any other objectionable commandment or law that interferes with the greatest good of the greatest number, in the opinion of the greatest politician of a particular generation?

Throughout Colonel Roosevelt's speech it remained undenied that if "the remaining resources of the Nation" now "belong to all of the people of the Nation," that in the beginning "all of the resources of the Nation belonged to all of the people of the Nation." Nor was it denied that East, North and South had received all of their portion of the common inheritance, nor was it denied that it is now claimed that the remaining portion of the Western States should be held for the benefit of "all of the people of the Nation." Nevertheless, a very brilliant rejoinder was made in the way of what we lawyers would call a confession and an avoidance. In fact, Colonel Roosevelt's argument was, first, to the effect that while the remaining resources of the Nation were to be held for the benefit of all of the people of the Nation, that the people within the districts where such property was situated would still receive greater benefits than ever therefrom. In other words, that all of the people, under this new system, would get all of the benefits of all of the property of the Nation, and the people of the district where it was situated would get more benefits than heretofore, which would seem to indicate that the argument is sustainable that a pint cup of water will fill a two-quart vessel, and that you can keep your cake and eat it, and have more cake when you get through than before you commenced.

Admitting, however, that the proposition really is to hold the remaining resources of the Nation for the benefit of all of the people of the Nation, and for the Federal Government through the public lands to exercise Federal authority and control throughout the Western States, such as cannot be exercised in the Eastern and other States not having public lands, nevertheless, it is asserted that while the Western States are to be shorn of their powers of taxation, of eminent domain and sovereign control over the public lands, and exceptional charges and burdens are imposed on the use thereof, that while this is "New Nationalism" and will take away these rights and functions from the Western States, still that the Federal Government, in the way of generosities and bequests, donations and family allowances, such as the Reclamation Service illustrates, has given a sufficient return.

Stated in other words, if the Western States have been deprived and are to be deprived of their sovereignty powers of taxation and eminent domain and made to submit to unequal taxation, so far as these rights are affected by the remaining public lands, that, nevertheless, it can be shown that in the taking away of this birthright, they have received a sufficient mess of pottage in return.

Obviously, the whole argument is beside the point. The rights and duties of the National Government, and of the several States, cannot be assumed by the one, or traded away by the other. The Nation has certain duties of government, and the States have certain duties of government, and each has reciprocal rights, duties and obligations and responsibilities, and the argument is hopelessly bad that these have been, or are to be, departed from, waived or exchanged for a sufficient and valuable consideration.

Conservation is appealed to as a National policy. Reclamation is claimed to be conducted on a basis peculiarly favorable to the West. However, reclamation in the West is conducted on the basis that the funds therefor must be obtained wholly from the sales of Western lands.

Appalachian Forests, however, are purchased and established, and reclamation in the East is carried on by appropriations directly from the general treasury, and not to be repaid. Upon the other hand, repayment for money advanced in Western reclamation is secured by mortgages, or liens, amounting to the same thing, upon the lands and homes of the small settler, who is thereby obligated to repay all that has been advanced, dollar for dollar. Having been born and having lived on a Western farm, and having lived all of my life amongst Western people, I apparently may not be expected to have an understanding of their needs such as arises from casual visits and political relation. Fullness of heart and deepness of affection belong apparently to those who are either doing politics or doing nothing. Therefore, my opinion that the loaning by the Federal Government of money derived from the sale of local resources for the development of the public use of irrigation in Western rivers, such liens to be repaid and secured by liens on the twenty, forty and eighty-acre farms and homes of poor settlers, is little short of extortion, must, I suppose, be read as the cold-blooded opinion of a cold-blooded corporation lawyer.

The people of the East and the North and the South have no desire or disposition to do injustice to the West. They are actuated by reasonable and generous motives. But while each section of the country can in a degree understand what pertains to the whole Union, such section can only understand those local matters that pertain to its own portion of the Union. Therefore, each section and each State should religiously hold on to, enforce and protect its own right, at the same time, with equal sincerity, re-

specting the rights of all other sections of the Union. The "parable of the four brothers" illustrates an undeniably correct situation, with equal relation to historical and present conditions, and the more it is argued against the more it will grow and the longer it will survive.

One of the most conspicuous features of Colonel Roosevelt's address was the total absence of any apparent realization that the Western States, as well as other States, possess powers of government and the powers and duties to regulate and control monopolies. As a matter of fact and of law, each and every one of the Western States, for all purposes of protecting itself and the people within the State from every kind of oppression and monopoly, has all of the powers possessed by any sovereign government in the world. Four-fifths of the States have no public lands, and, therefore, the Federal Government can act in those States only under the Constitution, and, therefore, when it acts otherwise through the public lands in the Western States, it, the Federal Government, acts not through the Constitution, but as a landlord, and arbitrarily and illegally.

Colonel Roosevelt is sincere, no doubt, in his view that the National development of irrigation benefits the people and prevents monopoly. I am not one of those who criticise the Reclamation Service; I think it has proceeded with more efficiency than is usual in connection with a politically managed business. I do not doubt its integrity, but informed persons know that many mistakes have been made that will cost the smaller settlers under the reclamation projects a great deal of money.

In every one of the Western States the development and beneficial use of water, whether for irrigation or power, is peculiarly and fully subject to the regulation and control of such State, not only as to charges, but as to service, and unless we wholly deny to the people of the Western States the capacity of self-government, no single one of these developments, no matter how large or how small the corporation may be that develops it, can ever become a monopoly in any hurtful or oppressive sense.

The true situation is that the cost to water users for equivalent uses under irrigation projects developed by the Federal Government have averaged nearly, if not quite, four times as much as the average cost for equivalent uses and benefits under what Colonel Roosevelt calls monopolies "of the very worst and most undesirable type." Further, it is true that the reclamation projects have necessarily been more expensive than the privately developed projects, but it can be fairly asserted that, the necessary cost considered and the equivalent benefits produced, the reclamation projects have been at least twice as expensive "to the poor small man" as has been the cost for similar service and values under these execrated "monopolies."

The doctrine of holding "all of the remaining resources of the Nation for all of the people of the Nation," instead of distributing the remaining property as rapidly as circumstances will permit, as far as possible to small ownerships and to actual settlers, and leaving the regulation of public uses to the State, is Socialism, pure and simple. It is the most drastic, sweeping and complete form of Socialism that could be suggested. If it had been adopted from the beginning, we would have had a "Nationalism," complete and perfect within itself, States ruled through the public lands and necessarily mere dependencies; people holding the lands as tenants or through National favor and under official surveillance.

You may call it progress, if you will, but it is progress backwards, towards the beginning of the world. It is the most Adamic, arbitrary suggestion of form of government that has been made in the last one thousand years. We are told that the government must be kept in the hands of the people. God knows we hope that it will, but how it can be so kept by the Government acting as a landlord, and through the public lands, we do not know. We choose an electoral college; the electors choose a president; the president appoints a secretary of agriculture; the secretary of agriculture appoints a forester; the forester appoints a district forester; the district forester a local forester; the local forester studies local conditions, ascertains what are and what are not monopoies, who are "malefactors," and who are good citizens, what should be taxed and what should not be taxed, what should be regulated and what should not be regulated. Then the local forester reports to the district forester; the district forester reports to the forester at Washington; the forester reports to the secretary; the secretary reports to the president; the president forgets that we have a Congress, and tells us what we ought to do, and adopts rules and regulations for our benefit and protection, and, lo and behold, government is restored to the hands of the people and the people rule! If this is not retractive progressiveness, headed straight towards the creation of the world, then I understand nothing of government, and have no knowledge of history.

We are all equally and profoundly interested in the preservation of our constitutional form of government and of our liberties and a continuance of the government in the hands of the people, in the prevention of monopolies in such a way as to not throttle industry or prevent progress. There is one way, and one way only, that this can be done, and that is by devoted, old-fashioned, patriotic adherence to our constitutional form of government, "rendering unto Caesar the things that are Caesar's, and unto God the things that are God's." To the Nation, all things that pertain to the Nation; to the States, all things that pertain to the States; to the end that this shall constitute and continue to be a real and actual govtrnment of the people, "an inseparable Union of indestructible States."

Very recently, and since the discussion before the Commonwealth Club, the United States Supreme Court, in a case appealed from Colorado, has affirmed the authority of the Federal Government, by virtue of its proprietary title to the public lands, to establish Forest Reserves and exclude trespassing stock therefrom. The decision does not go to any of the important questions discussed, but it is agreed that it does affirm the right of the Federal Government to establish, operate and protect such reserves in the public

interest, and to make rules and regulations for the full protection of its proprietary interest therein. This doctrine I have personally never controverted, and while the decision will for a time, no doubt, be widely misunderstood, it does not relate to or affect the question of the right of the Federal Government to deny to the State public uses over the public lands, such as can be acquired by eminent domain over other lands for railroads and other means of travel, telegraph and telephone lines, canals, ditches, and the like, nor does it in any manner suggest the right of the Federal Government to exercise any powers of government or control or impose any taxes or excises of an unequal or unusual nature in any State. This case and the Kansas-Colorado case, above referred to, might well be agreed to as settling the law that as a proprietor in the public interests, the Federal Government may make all needful rules, regulations and reservations that it may desire to make in connection with the public lands, but that it cannot, under the guise of such lands or through reservations made of the same, exercise any exceptional powers of government in any State: impose any exceptional or unequal taxes, or excise or other unequal charges therein; or prevent the construction of roads, railroads, telephone or telegraph lines, or canals or ditches or other public uses therein. I have constantly adhered to this view, and have always agreed as to the full authority of the Federal Government for the protection of its proprietary interest in the public lands. In any event, the Supreme Court of the United States decides the law, and it is the duty of all loyal citizens to conform thereto. I am, therefore, thankful that we are reaching a point where if extreme conservationists will assume the same attitude, where the decisions are against them, we can proceed in an orderly and well understood way in accordance with the law. It will be observed that the Supreme Court passes on no question of policy or the equities most discussed in our argument. Such questions are stated to be for Congress, not for the courts.

CHINESE TELEPHONE AND TELEGRAPH SYSTEMS.

Consul General Amos P. Wilder of Shanghai states that improvements in the telephone and telegraph systems of the Chinese Empire are being made in accordance with a program adopted by the Board of Posts and Communications. This program was arranged to cover nine years, beginning with 1908 and ending with 1916. An abstract of the program, showing the improvements yet to be made, follows:

During the present year depots will be established for experiment purposes and also for the manufacture of telegraph and telephone instruments and materials. The following additions will be made to already existing telegraph lines: In Hunan, Hunkiang and Yungchow lines; in Honan, the Chow-chia-kou and the Haochow lines in Amuri; in Manchuria, the Anhui Province lines; in Kwangtung, the Kaochow-Pi-ching lines. Plans will be made for the erection of wireless-telegraph stations along the seacoast. Experiments will be made with automatic telephones in the city of Peking. The telephone systems at Tientsin and the Provinces of Kiangsu and Chekiang will be extended and enlarged.

In 1912 the northern and southern telegraph circuits of Shensi and Shansi Provinces will be extended, as well as certain lines in Kwangtung Province from Foshan to Hsun-teh-hsiang-shan. Officers will be sent abroad to investigate foreign-made electrical materials and compare them with materials manufactured in China. Telephone and electric-lighting systems in Hupeh Province will be extended, and telephone installations in Hunan and Shantung Provinces will be experimented with.

In 1913 China will participate in the international electrical conference. Telegraph lines will be constructed from Fuchow in Kiangsi Province to Yingchih in Fukien Province, and from Chi-an in Kiangsi to Ti-ling in Hunan. Experiments are to be made with automatic telephones at Canton, Tientsin, and Shanghai; and with telephones in Shensi and Honan Provinces.

In 1914 telegraph lines will be extended from Hsing-i in Kwei-chow to Kwangnan in Yunnan and from Chengtu to the capital of Szechwan Province and to points in Kansu Province. Further depots for the experimental manufacture of electric lighting, submarine cables, and all kinds of materials for electrical appliances will be established. Telephone systems will be tried in the Provinces of Kweichow, Yunnan, Szechwan, Kwangsi, and the systems already in operation in Shansi Province will be extended.

In 1915 extensions will be made to the lines between Pu-erh and Hsunning in Yunnan; and to the lines between Ching-yuan in Kwangsi and Kuei-yang in Kweichow. A survey will be made for a line between Urga and Kobdo, Mongolia. A depot for the manufacture of all materials used in wireless telegraphy will be enlarged. Experiments will be made with telephone systems in Kansu and the New Dominion (Hsin Chiang). Telegraph lines in both inner and outer Tibet will be extended.

In 1916 telegraph lines in inner and outer Mongolia will be extended. Plans will be made for the construction of telegraph lines from Pao-t'eu-Chen to Ning-hsia, from Kansu to Ching-hai and inner Tibet, and from Ili to Kuche. The telegraph lines in the northwest Provinces will be reconstructed and the general improvement of all the electric-lighting plants and telephone systems in the Empire will be undertaken.

It is impossible to say how much of this program will actually be put into operation, much depending upon the funds at the disposal of the Board of Communications. Only by stationing a representative at Peking who will have access to the officials of the board will it be possible effectivly to keep in touch with the actual operations in the way of the construction and extension of telephone and telegraph lines in this Empire.

The steel motor cars used in the Alameda electrification of the Southern Pacific Company are 73 ft. long and 10 1/3 ft. wide, with 23¾ in. aisles and two and three-passenger cross-seats. They seat 116 passengers and one motor and one trailer car has a weight of 761 lb. per passenger seat.

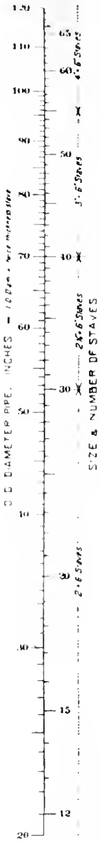
WOOD STAVE PIPE.

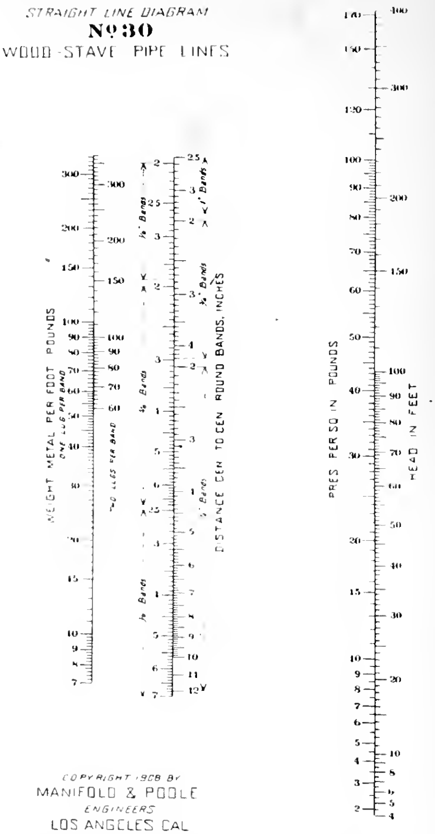
The accompanying diagram, published by permission from Manifold and Poole's "Straight Line Engineering Diagram," is used for designing wood stave pipe and estimating the quantities of materials required. It is seen to consist of eight vertical scales, No. 1 gives the outside diameter of the pipe in inches, No. 2 the corresponding size and number of staves, No. 3 the weight of metal per foot with one lug per band and No. 4 with two lugs per band, No. 5 and 6 the distance from center to center for various sized round bands, No. 7 the pressure in pounds per square inch and No. 8 the corresponding head in feet. Problems are solved by connecting No. 1 and No. 8 by a straight edge and reading the required results on the intercepted scales.

Scale No. 2 shows directly the size and number of staves required. For instance, a 48 in. pipe made with staves 1½ in. thick would have an outside diameter of 51 inches and require 29 staves. As the staves are from 2x6 in. stock, 29 board ft. of lumber would be necessary per ft. of pipe.

A tensile strength of 60,000 lb. per sq. in. is assumed for the steel in the bands, with a factor of safety of 4. Swelling of the wood is assumed at 100 lb. per sq. in.

Example. A 48 in. wood stave pipe has an outside diameter of 51 in., find the distance between center of ⅝ in. bands to sustain a head of 48 ft., also the weight of metal in bands and shoes per foot of pipe.





Solution. Connect 51 on Scale No. 1 to 48 on Scale No. 8 and read 5.9 in., on Scale No. 5, the distance from center to center, and 36 lb. on scale No. 3. If the bands were of 1½ round, the distance from center to center would be 3.8 in. as found on Scale No. 6.

The following information on the characteristics of wood stave pipe, its use and cost is abstracted from a paper presented by T. C. Hatton at the annual convention of the American Water Works Association, June 5-9, 1911:

There are two distinct forms of wood stave pipe in common use. One is termed "continuous" and the other "machine made." Both are built of the same character of wood, and the staves are of equal thickness for like pressures. Those built into "continuous" pipe are made of uniform thickness, throughout their lengths, with a bead on one longitudinal edge and with a saw kerf at each transverse edge into which a metal plate is inserted to make a water tight joint. The bead on the longitudinal edge serves to make a water tight joint by being squeezed into the face of its neighboring stave when the iron bands surrounding the pipe are cinched up. The staves are made in unequal lengths to enable joints to be broken in constructing the pipe. The staves are held together by round iron or steel bands of such diameters and spacing as will retain the pressures required, each end of the bands passing through a malleable iron shoe and having a thread to which a nut is fitted. Thus the staves can be brought together so close that no leakage can occur unless it oozes through the grain of the wood.

This form of wood pipe is built in the trench, and from 16 ins. to any diameter required, but is more commonly used for pipes over 24 ins. in diameter. It has one special feature well worth noting, if the pipe leaks at any point in the longitudinal joints, these leaks can be easily stopped by cinching up the bands near the leaks or if some defect shows up in the pipe line a few years after building, sections can be easily removed and replaced, by substituting new staves, or new bands.

The staves built into "machine made" wood pipe have two beads upon one longitudinal edge and two corresponding grooves in the other longitudinal edge. The beads are a little larger than the grooves, thus insuring their being totally filled and made water tight. At one end there is a tenon, cut 4 ins. long, where the staves are one-half the thickness of the balance of the walls of the pipe. On the other end there is a chamber cut 4 ins. deep. The tenon is smaller in diameter at the end than at the shoulder and when driven into the chamber makes a water tight joint, even though the two shoulders are not in perfect contact.

The staves are cut radially to correspond with the diameter of the pipe, and are held together by a steel band, steel wire or copper clad wire. This band or wire is wound spirally upon the pipe by a machine. The high tension produced by the machine squeezes the beads into the grooves making a longitudinal joint that cannot leak so long as the elastic limit of the band is not overcome.

Where steel is used for banding the pipe it is run through a bath of warm asphalt, which adheres to its surface, thus protecting it from any water which might ooze through the grains of the wood. After the pipe is wound, and the tenon and chamber cut, it is rolled in a bath of hot asphalt which adheres to the outside of the steel and wood protecting them from outside oxidizing agents. It is then rolled in a bed of sawdust. This sawdust enters into the asphalt and forms a protection for it in shipment and handling.

"Machine made" wood pipe are made in lengths from 5 to 12 ft. and shipped to the work ready to be laid. They are laid by driving one piece into another until the two shoulders are in contact, or nearly so. No skilled labor is required; the inspector standing on top of the trench can readily observe whether the pipe has been driven home by observing the two shoulders. This form of pipe is made for diameters from 3 ins. to 36 ins. Either form can be laid around curves of from 90 to 200 ft. radius, according to the diameter of the pipe.

One of the usual questions asked is, "What pressure can wood stave pipe safely withstand?" The proper reply to this is that the tensile strength of the material composing the bands represents the pressure the pipe will stand. Wood pipes are made to withstand pressures up to 200 lbs. per sq. in., so far as the writer knows. The more the pressure under which the pipes are subjected, the more steel or wire is required to band them together.

As the tensile strength and elastic limit of iron and steel are well known, it becomes a simple matter of computation to determine the gage and spacing of the bands to make a wood pipe which will withstand any pressure up to 200 lbs. Beyond this pressure it is likely the water would waste through the pores of the wood so that a higher pressure would not be economical or practicable.

The writer has experimented with wood pipe up to a direct pumping pressure of 300 lbs., without fracturing the pipe. This experiment was made to ascertain what a pipe built for pressures up to 100 lbs. would do if it was subjected to a water hammer equal to three times the pressure. At 250 lbs. the water oozed through the walls of the pipe. At 300 lbs. it spurted in small streams at a few of the longitudinal joints, with a few leaks at the transverse joints. The pressure was suddenly removed to nothing, and gradually brought up to 100 lbs. with the result that the leaks stopped. This showed that, while the steel bands had been stretched, the elastic limit had not been overcome, and the pipe would, under such conditions as frequently exist in a long pipe line, safely withstand a wide range of pressures suddenly applied.

Pressures from 100 to 150 lbs. are common in machine made wood pipe, while continuous pipe of large diameter is successfully operating under pressures from 80 to 130 lbs.

Assuming that wood stave pipe is laid where it will be constantly subjected to water pressure the life of such is entirely dependent upon the life of the material with which it is banded. While the life is somewhat problematical there are well known illustrations where steel banded pipe has been in continuous operation for 50 years without apparent deterioration. While the writer has industriously made inquiries wherever such might be expected to give reliable information he has failed to learn of a single case where steel bands have given way on machine made pipe.

The engineer who designs a continuous wood stave pipe provides for at least a factor of safety of 3 in determining the size and spacing of his bands. The manufacture of machine made pipe provides for an equal factor of safety. Now when steel or iron corrodes it does so by pitting, and thus it is reasonable to assume that two-thirds of the cross-section of the steel can oxidize before the band will fail under ordinary conditions. From the writer's observation sheet steel, such as composes the bands of machine made wood pipe, pits in irregular spots, and never on a straight line, thus the band may be two-thirds gone before the pipe will fail.

Where oxidizing agents are known to exist, such as in salt marshes, through salt water or sulphur deposits, the pipe should be banded together with copper clad steel wire. This copper clad wire is cheaper than solid copper wire. It has an elastic limit of about 50,000 lbs. per sq. in., a tensile strength of from 90,000 to 100,000 lbs., and a coefficient of expansion less than two-thirds that of copper. Thus it becomes a product equal in strength with the steel and far better than copper. The writer knows of several cases where copper clad steel wire wound wood stave pipe has been successfully used where cast iron and steel pipe were unsuccessful.

The claim is made by wood pipe manufacturers that wood pipe has a greater carrying capacity than cast iron pipe of equal diameter, and from a few well conducted experiments this claim seems reasonable. Marx, Wing and Hoskins of Stanford University conducted careful experiments to determine the coefficient of friction in wood pipes. They found that coefficient n amounted to .009. Mr. Campbell on the El Paso and Southwestern Railway pipe line, found the value of n in 13,200 ft. of 10 in. wood pipe to be .00806, and in 47,500 ft. of 16 in. wood pipe to be .0092. Mr. Campbell had exceptional facilities for determining the true values of n which are rarely found in actual practice.

The value of n in new cast iron pipe has been determined repeatedly and found to be .012. From the results of these experiments it appears quite true that a wood pipe has greater capacity than cast iron of like diameter. For instance a 12 in. wood pipe with a loss of head of 8.85 ft. per 1000 will carry approximately 2025 gals. per minute, whereas a new 12 in. cast iron pipe under the same loss of head will carry about 1810 gals. per minute. A 30 in. wood pipe under

a loss of head of 2.05 ft. per 1000 will carry about 11,600 gals. per minute, whereas a 30 in. cast iron pipe under the same head will carry about 8810 gals. per minute. The longer the cast iron pipe is used the less its carrying capacity, under frequent conditions. The capacity of wood pipe does not diminish with age, the inside perimeter becoming smoother from use.

So far as the writer's knowledge goes there have been very few well conducted observations made of the leakage from wood pipe lines. From general observations made by the writer of lines in operation, no leaks of any significance have been apparent. Mr. Campbell, however, conducted careful observations on his lines, and states that, after two years, there was no material leakage in the 10 miles of 10 in. and 16 in. wood pipe line between the source of supply and the reservoir, which pipe was working under a maximum pressure of 130 lbs. That in the 12.6 miles of 11 in. and 12 in. pipe lines below the reservoir, and subjected to a less pressure, the 11 in. line leaked 17.046 gals. per mile and the 12 in. about 3.702 gals. per mile. Along the railway, when the maximum pressure was 130 lbs. the 11 in. pipe leaked 120 gals. per mile, and 8½ in. and 7½ in. pipe leaked 268 gals. per mile. It occurs to the writer's mind that if there were 103.4 miles of wood pipe in this installation wherein the maximum leakage was 268 gals. per mile, and 8.6 miles wherein the leakage amounted to 17.046 gals. per mile, there must have been some defective joints or pipes in the latter section which needed looking after, that if 90 per cent of the whole line was practically water tight, the other 10 per cent could easily be made so. However, from the result of the careful observations made by Mr. Campbell, it seems reasonable to assume that wood pipe, properly made and laid, can be made water tight under a pressure of at least 130 lbs.

This subject may be concluded by considering the difference in cost in installing wood stave and cast iron pipe. This difference is made up of several items, as, for instance: the cost of the two characters of pipe delivered f.o.b. cars at nearest railway point. Hauling pipe alongside of trench, width and depth of trench. Laying pipe, etc.

The difference in cost of furnishing and delivering the two characters of pipe at railway points is largely dependent upon the difference in diameters of the pipes to be used. The larger the diameter the greater the difference. The difference in weights per foot of pipe also increases in direct ratio to the increase in diameters. Therefore the cost of transporting wood pipe from railway to trench is from one-third, for wood pipe 8 ins. in diameter, to one-sixth, for wood pipe 30 ins. in diameter of the cost of transporting cast iron. To overcome frost conditions the wood pipe need not be built as deep as cast iron pipe, as wood is a good nonconductor and can be laid closer to the surface of the ground without being damaged by frost. In laying wood pipe no bell holes are necessary, and this item of cost is eliminated, which, in rock excavations, becomes a very important item. As there is no lead and hemp used in laying wood pipe these items of cost are eliminated, as is the cost of melting lead, transporting and furnishing fuel, and caulking joints.

While it is impossible to compile a table showing the difference of cost between furnishing and laying the two characters of pipe which will fit conditions existing generally, it can easily be determined at a glance that there is a difference in favor of wood pipe; that this difference depends upon the size of the pipe, and that it can easily be determined for each locality when freight and labor charges are known.

A few instances of known costs might be interesting. The 23 miles of 30 in. continuous wood stave pipe laid for supplying Lynchburg, Va., with water, under the direction of Mr. James H. Fuertes, M. Am. Soc. C. E., cost, for furnishing and laying pipe, exclusive of trenching and backfilling, from $1.82 to $2.10 per lin. ft., depending upon spacing of bands. This wood was shipped from the Pacific Coast at a freight rate approximately $300 per car.

The 42 in. continuous wood stave pipe laid as a supply main for the Atlantic City Water Works, under the direction of Mr. Kenneth Allen, M. Am. Soc. C. E., cost, exclusive of trenching and backfilling, $2.25 per lin. ft.

The 24 in. machine made pipe line laid under the direction of the writer for Carney's Point, N. J., cost, exclusive of trenching and backfilling, $1.32 per lin. ft.

Comparing the above costs with the cost of cast iron pipe of equal diameter, delivered f.o.b. cars at railway point, and the cost of lead and hemp for making joints, omitting transportation charges from railway to trench, laying charges, extra excavation for bell holes, fuel for lead melting, caulking and handling cast iron pipes:

The 42 in. cast iron pipe would cost at $22 per ton........$6.11
The 30 in. cast iron pipe would cost at $22 per ton........ 3.47
The 24 in. cast iron pipe would cost at $22 per ton........ 2.43

The difference in cost of laying wood and cast iron pipe including trenching and backfilling, and under exactly the same conditions, is well set forth in Mr. Campbell's paper above referred to.

He states that the 384,300 ft. of wood pipe from 11 to 3½ in. in diameter were laid at an average cost of $0.0472 per lin. ft., whereas the 101,200 ft. of 12 in. cast iron pipe, including lead and hemp, were laid at an average cost of $0.2343 per lin. ft.

It is not the writer's purpose to recommend to his colleague, who may be interested in laying supply mains for water works, wood stave pipe under all conditions, but to suggest that, after knowing the conditions, he look into the advisability of using wood stave pipe, study its applicability to the existing conditions, including the comparative cost with cast iron or steel pipe, keeping his mind open to recommending the installation which will best suit the conditions, and he will find many circumstances when he can save his client's money and secure for him equal service.

Wood stave pipe has long been familiar to western engineers and water works superintendents. The great cost of transporting cast iron pipes from the East was prohibitory and engineers were forced to use wood pipe. These, however, have proven so efficient after many years' trial that they are being used wherever conditions are proper.

VALUATION DEFINITIONS.[1]

BY HENRY FLOY.

Depreciation, like perpetual motion, implies constant action; but only in this are they alike, for as the practitioner knows, depreciation is an inexorable reality while perpetual motion is but an alluring chimera. Webster defines "Depreciation" as the "act or state of lessening the worth of," and in this sense it will be used by the writer regardless of the source or method of worth reduction, or by what means it may or may not be removed. The term "amortization" has been used somewhat indiscriminately for depreciation, but it should properly be applied only to the laying aside of funds at a uniform rate for the ultimate replacement of capital investment; and in this sense alone will be used by the author.

Depreciation has been used to mean:

1. The annual amount expressed, as a percentage or in dollars, that should be laid aside to renew or replace the article in question at the time of its abandonment. In this use of the term, the loss of worth, which can be made good or replaced through ordinary maintenance or repairs, is not included as a part of depreciation, but is provided as a part of the regular operating expenses. This, until comparatively recently, was the more common use of the term depreciation which was applied particularly to renewals and replacements. Used in this sense, the term "depreciation" is somewhat academic and theoretical, and may or may not represent any actual financial outlay.

2. The annual amount expressed, as a percentage or in dollars, that should be laid aside to renew or replace the article in question at the time of its abandonment, plus the annual expense of maintenance and repair expended in removing such part of depreciation as is practicable and good economy. This then includes all classes of "lessening of worth" and is the application of the term preferred by the writer and used by the New York Public Service Commissions in their rules for uniform accounting.

3. The total amount—it may be the sum of several years of depreciation—expressed in a percentage or in dollars, that must be deducted from the "original cost" or the "cost to reproduce new" in order to obtain the present value. The determination of the amount of depreciation at a given time, in connection with the valuation of a property, is merely the summation of the annual accrued amounts of deterioration, which, from the time of installation, have been continuously reducing the worth of the property, less such value as has been restored by expenditures for wear and tear, replacements and renewals.

Physical Value. This expression is usually recognized to represent those elements of cost incurred in installing and putting the physical property in a condition to begin operation. It includes primarily, "those things which are visible and tangible, capable of being inventoried"; but secondarily, certain non-physical charges "which are an inseparable part of the cost of construction but which do not appear in the inventory of the completed property." These secondary values which are to be included as a part of the physical property are expenditures for such items as:

1. Engineers' and architects' fees, including cost of design and testing all construction and equipment, etc.

2. Administration expenses chargeable to construction, including superintendence, inspection, accounting, salaries of officers and clerks, consents of authorities and property owners for temporary work or use, legal expenses, rent, printing, storeroom expenses, etc.

3. Provision for various incidentals and contingencies, incomplete inventories, unforseen requirements, etc., which practical experience has shown to be necessary.

Development Expenses, Intangible or Overhead Values. Any one of these terms is generally used to include certain expenses, which, while a necessary part of the complete cost of a going property, are not costs inherently a part of the construction of the physical property, as such.

Development expenses generally cover most or all of the following expenditures:

1. Legal and other expenses of preliminary promotion, incorporation and organization, procuring consents of property owners, condemnation proceedings, obtaining franchises, consents and certificates from Public Service Corporations and other public bodies, title examinations and insurance.

2. Technical expenses in connection with preliminary work, surveys, expert estimates, etc.

3. Interest on capital and bond issues, wages of superintendence and administration not chargeable to construction ordinarily necessary in connection with putting a property in going order; and also sometimes the deficiency in operating expenses and taxes until the property is put on a paying basis.

4. Taxes of various amounts including corporation tax, mortgage tax, real estate tax, personal property tax, capital and State tax, franchise tax, etc., which must be provided and paid until the property is completely a "going concern."

5. Discounts on securities, brokerage or other customary and necessary expenditures in connection with financing such an undertaking and marketing securities.

6. Reasonable promotion profit, possibly also compensation for risk of capital, estimated at 5 to 10 per cent of the cash investment.

Development expenses are not ordinarily depreciated in the same way as the physical property, though some authorities have indicated such procedure is proper. Development expenses may well be amortized, but the rate of such amortization has no necessary connection with the rate of depreciation of the physical property. The rate of amortization of development expenses might well be based on the life of the securities, for example, 50 years, whereas the depreciation of the physical property would have to be based on its rate of deterioration through life, which the Wisconsin Commission reports to average for electric lighting properties, 17.46 years, tele-

[1]Extracts from paper to be presented at 28th Annual Convention A. I. E. E., Chicago, June 26, 1911.

phone plants 11.24 years, and electric railways, 18.02 years.

Original Cost. As the term indicates, this refers to the actual amount of money paid for the physical property including original construction plus all additions since that time. Original cost should be shown in the books of corporations, but is not always there obtainable. In making deduction for depreciation all authorities agree that the value of any property that has been abandoned or discarded should be entirely written off, unless possibly the earnings have been so small as to preclude doing so at once without unfairness to the stockholders or bankruptcy to the corporation.

Cost to Reproduce New, or Cost of Reproduction. These terms, so much in evidence nowadays, refer to an estimated value based on the cost of reproducing the physical property new, on the basis of prices current at the time of estimate—prices that fluctuate considerably are averaged for five years preceding—and is made up to include everything that can be inventoried regardless of original cost, age, service value or present condition as effected by depreciation.

Scrap Value. All physical property unless offset in whole or in part by cost of removal, has a certain scrap or junk value beyond which there is no depreciation, hence physical property can only deteriorate until it reaches its scrap value. This value is simply the fair market price that a purchaser will pay for the property in its disintegrated condition. If a property consisting of its several elements is usable not as junk but as serviceable property elsewhere, a higher price than scrap value is obtainable, and this worth has been characterized as "salvage value" or "minimum going value."

Wearing Value. If from the cost—taken on whatever basis is determined to be the correct one—there is subtracted "scrap" or "salvage" value of given physical property, the remainder is a value known as "wearing value," which will deteriorate more or less rapidly and entirely pass away, as regards the installation being considered, at the expired life of said property, which life ceases through age, inadequacy, obsolescence or sudden damage.

Service Value. Physical property, honestly and intelligently purchased with a view to its suitableness for the service intended, aside from some hidden defect or untoward accident, maintains its original value practically throughout its life except for such deterioration as results from wear and tear or deferred maintenance. The life of the property may expire normally through age or prematurely through inadequacy or obsolescence but these two latter classes of depreciation develop quickly so that for the larger part of the time used, the service value of property will approximate original cost. Service value must not be confounded with going value. Service value results from the use of the property in the place and for the purpose for which it was intended. Going value may or may not accrue in addition to, and, over-and-above service value. Going value relates to establishment of earnings while service value exists regardless of earnings.

Present Value. This expression refers to the estimated worth of the physical property as it exists at the period being considered. It may have one of several values, some purely academic and artificial as explained more fully hereafter, depending on what application is made of the theory of depreciation and therefore, present value always needs some qualification or explanation as to the sense in which the term is used. The more frequent application of the term is to that value obtained by deducting from "original cost" or "cost to reproduce new," the accrued depreciation, which may be either absolute depreciation or the sum of both absolute and theoretical depreciation. Though usually so, "present value" does not necessarily include a deduction from cost to cover deterioration as is illustrated in the valuation of the Texas Railroads made by the Commission of that State, where no deduction from cost of reproduction was made on account of existing wear and tear or normal deterioration.

Appreciation as well as depreciation must be considered in determining "present value" as indicated by the Supreme Court.

"Original cost" or "cost of reproduction new," in connection with depreciation of the physical property inventoried is quite generally used in determining present value.

In estimating "present value" it is perhaps unnecessary to state that "second hand," "scrap" or "forced sale" values are not the "fair values" to be considered in connection with a "going concern." This has been repeatedly affirmed by the courts.

In obtaining the depreciated value of "used or useful" property, worn out or replaced inventoried material which has no value except for sale, may be put in at scrap or salvage value, unless such property is being carried merely to artificially increase value.

Going Value. This refers to an estimated worth recognized by the highest courts and ingeniously figured and allowed for by at least one State Commission in connection with a wise expenditure made in increasing the business of an established plant.

Good Will. A monopoly, as is generally admitted, has no good will which can be evaluated, and the courts have sustained this view. Good will can only result where competition exists and the tendency of the times is to make no allowance for this element in a public utility valuation; it being considered that good will belongs rather to industrial enterprises where its value is determined by the profitableness of the business; namely, capitalizing the net income. Good will has no value which must be considered in dealing with the subject of Depreciation.

Franchises. As the term indicates, it is the right to "do business." Formerly franchises were considered more or less valuable assets and in some instances, have been recognized and allowed for by the courts; but the present tendency, largely by reason of legislative enactments, is to prohibit the capitalization of franchises beyond the absolute expenditures made in good faith in obtaining said franchises. Depreciation of franchises depends on their terms and has no relation to deterioration of the physical property although the expiration of a franchise might easily reduce service value.

THE WESTINGHOUSE ANNUAL REPORT.

The report of the Westinghouse Electric & Mfg. Company to be presented at the annual meeting on July 26, 1911, shows gross earnings of $38,119,112, and net income of $4,881,106 for the year ending March 31, 1911, the largest in the history of the company. The gross earnings exceeded those of the preceding fiscal year by nearly nine million dollars and were over five million dollars greater than the earnings of the best preceding year.

As these results were reached during a period of less than normal activity in other lines of industry, they afford sound basis for continued hope in the future of the electrical manufacturing industry. However, the volume of business now offering is on a diminishing scale, and the results of the last year, are no certain indication of a continuance for the future of gross earnings and net profits such as the past twelve months have produced. The business taken by the company during February and March, 1911—the last two months of the fiscal year covered by this report—was somewhat less than that taken during the same months of 1910, and the value of the orders booked since the close of the fiscal year does not compare favorably with that of the corresponding period a year ago. The value of unfilled orders as of March 31, 1910, was $11,256,196; as of March 31, 1911, this value stood at $7,616,058.

The fifteen-year agreement with the General Electric Company whereby each company licensed the other under the patents controlled by it expired by limitation of time on April 30, 1911. No renewal of it is contemplated. Other patent license agreements with manufacturers of mining locomotives, small motors, fuses, switches and sockets, under which the company has been working for some years, have recently been cancelled on the suggestion that they might be questioned as being in violation of the Federal anti-trust laws.

Considerable increase has been made in the expenditures of the selling organization, for increasing the number of salesmen in the field, for remuneration to its representatives adequate to secure the best effort on their part, for the extension of advertising, and to provide for proper warehouse facilities for carrying stocks at distributing points.

Large expenditures have been authorized for the work of new development and for improvement in current types of apparatus. This work has been particularly marked with respect to the redesigning of direct current motors, alternating current and direct current mill and crane motors, small power motors, high speed turbo-generators, circuit breakers, railway equipment and heating and cooking apparatus.

The company was made party defendant, together with the General Electric Company, the National Lamp Company and a number of other lamp manufacturers, to a bill in equity recently filed by the United States under the provisions of the Sherman anti-trust law. This bill proceeds on the theory that certain agreements and acts of the lamp manufacturers, defendants in the suit, constitute a combination in restraint of trade. The directors say that the company's operations have been such that the outcome of the suit is not likely to seriously affect the conduct of its lamp business.

The securities of the Westinghouse Electric & Manufacturing Company carried at their face values are as follows: Capital stock (assenting) $1,507,-048; convertible sinking fund bonds, $266,000; bond scrip, $1,150.50; total, $1,774,198.50.

The assenting capital stock was acquired partly by the several subsidiary companies in settlement of accounts due them by the Westinghouse Electric & Manufacturing Company at the time of the receivership, and partly in settlement of disputed relations existing at and after the receivership between the Westinghouse Electric & Manufacturing Company and Security Investment Company. The stock is carried as an investment with the intent that at a favorable time it shall be resold.

The convertible sinking fund bonds have been acquired and are held in anticipation of sinking fund requirements. The bond scrip represents scrip purchased to be exchanged for bonds, also to be held for sinking fund purposes.

The following are known as the "Subsidiary Companies" of Westinghouse Electric & Manufacturing Company: Westinghouse Lamp Company, The Bryant Electric Company (The Perkins Electric Switch Manufacturing Co.), R. D. Nuttall Company, Westinghouse Electric & Manufacturing Company of Texas.

The operations of the British company have been "quite uniformly unprofitable." The French company has been "steadily unprofitable," but the Italian company has succeeded in making some money for its parent corporation. On the contract for the electrification of the St. Petersburg tramways, the company lost over a million, and had much trouble with the authorities, who seized its private papers and otherwise molested the local officers. Up to date Russian propositions have cost the Westinghouse people more than $1,800,000. Disputes over fines imposed by St. Petersburg on the company are still being waged in the Russian courts. In Austria the company has been "measurably" successful in its operations. The Canadian organization has also done well.

The total book value of power-company securities carried is $211,498.24. The total book value of all investments is given as $24,034,635.99. "The ownership of the securities of power companies constitutes the sole foundation in fact for the statements from time to time appearing in current periodicals and Government reports of the connection of the Westinghouse Company with a so-called 'waterpower trust.'"

Chairman Robert Mather concludes his report by stating: "After a careful consideration of all of the circumstances, having due regard for the true condition of your balance sheet, hereinbefore minutely described to you, the elements of uncertainty as to the immediate future of your company's business, the need for cash for new foundry facilities, for extension of the Newark plant and other factory improvements, and the necessity of making wise provision for shortly maturing obligations, your directors have felt that it is not wise at the present time to weaken your company position by diverting its surplus earnings, even in part, to the payment of dividends on the assenting stock."

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Publishers' Announcement

We take pleasure in announcing that on July 1 Robert Sibley of Missoula, Montana, will assume the position of editor-in-chief of the Journal of Electricity, Power and Gas. To this task he brings a wide experience as an operating and consulting engineer, the technical knowledge of a university professor and early training as an editor.

A Southerner by birth, Mr. Sibley is a Westerner by adoption. Preparing at the Los Angeles High School, he graduated from the College of Mechanics of the University of California in 1903. Here he founded and was first editor of the California Journal of Technology. Gaining the highest honors from both the student body and the faculty, he was called as professor of mechanical engineering at the University of Montana after serving for a brief time as electrical engineer in charge of the Mariposa Commercial and Mining Company's hydroelectric installation. At the University of Montana he was soon made professor of electrical engineering also, being dean of the school of engineering for two years prior to his resignation in 1907.

For the past four years he has been practicing as a consulting engineer at Missoula for many power and irrigation projects in the Bitter Root Valley and Western Montana. He carried on a series of investigations for the Bunker Hill & Sullivan mine, the Federal Mining Company, the Hercules and Hecla mine and was called as an expert in the damage suits of the Chicago, Milwaukee & Puget Sound Railroad of Montana. He is a member of the American Institute of Electrical Engineers and the author of many articles in the technical press.

Corporation Breaking

Federal prosecution of the great corporations is now so active as to lead many to believe that the law intends to destroy this convenient means of conducting business. Perhaps some of them will be abolished, just as an unusually high-spirited horse is sometimes killed while being subjected to a similar breaking process. But the great majority of corporations will thereby merely be made amenable to discipline, "broke to ride and drive," and become of even greater utility in the social structure. No better commercial vehicle has yet been devised to replace the corporation, as the automobile is being substituted for the horse, and until such is found the corporations should be allowed to continue.

Human progress has ever been based on a process of taming wild forces, first by might, later by reason. The first to be subjugated were the ox, the ass and the horse; then fire was made a servant, the water-fall was mastered, the wind was subdued, steam was confined, and finally the lightning was restrained. Titanic Nature, who once struck fear to the heart of man, is now constrained to do his will, namely, to provide means of getting closer together.

Every day men are getting closer together by railroad, by telegraph and by telephone. Is it any wonder that business has similarly been centralized in obedience to this primitive gregarious instinct? How futile it is to make laws "to prevent business from getting together" when each new conquest of Nature lowers the barriers of time and distance which tend to keep men apart. Yet the legislators persist in trying to build an impenetrable wall to stop the irresistible ball propelled by scientific progress.

Without electricity, the modern corporation would be impossible. As recently stated by George W. Perkins, "a corporation is a composite of steam, electricity and men." We do not dispense with the action of steam, of electricity or of men because, unregulated, they are capable of harm. Individually, they may be so supervised and controlled as to be made useful. Why not collectively?

Wood Stave Pipe

Wood stave pipe is in successful use throughout all the Pacific Coast States where the service has been unusually severe, either from climatic extremes, heavy pressures or unfavorable ground conditions. Wood has been extensively employed for underground closed water conduits in the United States since the founding of this government, although the built-up variety is comparatively new, especially in large sizes. The increase in size and output of hydraulic power systems, whose water must be carried under pressure, made it popular wherever the cost of iron and steel was prohibitive or where these materials could not be easily obtained.

Wood-stave pipe while of doubtful permanency, has a lower friction factor and offers greater resistance to collapse. Steel of an economic thickness for the upper end of a long pipe, where the hydrostatic head is less than one hundred feet, is so thin as to be liable to collapse. Cast-iron, while thicker, is more costly. The durability of steel varies greatly with locality, in some places "rusting out" in a few years. Cast-iron pipe constantly filled with pure water has long life at any point. It is interesting to note, however, that the early Californian hydraulic miners would not buy riveted pipe constructed of steel plates, but insisted upon wrought iron as having longer life. These pipes were carelessly handled, seldom buried in trenches and were as often empty as full. Yet after forty years they may still be found either in service or capable of withstanding the pressures for which they were built. However, they were seldom over twenty-four inches in diameter and exhibited a disconcerting tendency to collapse. The firm belief in these old metal pipes and a natural fear of wood decay created an early prejudice against its use sometimes apparent to this day.

Another relic of early mining practice is the open timber flume. With timber at hand and a service not injured by occasional interruption, this was the cheapest and most logical method of carrying water in the hills. Its rapid depreciation makes it inadequate for modern power supply except under unusual conditions or with a small quantity of water. Such objection does not apply to wood-stave pipe, which is closed and under pressure and thus subject to the preserving action of constant immersion. The greatest possible external pressure which may cause collapse is that of the atmosphere, which all but the lightest wood stave pipe can readily resist.

For carrying mater on canal grades, this form of pipe costs little more than either open canal or timber flume; it has a lower friction factor and prevents the loss from evaporation.

It is significant that many large stave pipes have been in continuous power plant service for ten years or more, and, with very little repair, give every evidence that another ten years will find them still in service. Care in the selection of the wood for staves, straight grain, free from knots and properly dried, is essential, redwood here being better than pine or spruce. Failures in these pipes have probably been due to either improper design or the careless selection of materials.

As the pressure is increased, the amount of steel necessary in the bands holding the staves in place, increases in direct ratio. These are calculated for strength in the same manner as is steel pipe, and therefore a point is reached where the cost of the wood pipe equals that of steel. At this point the comparative values are in favor of the steel and in fact the limiting pressure should occur some time before that point is reached. A further limitation is the pressure at which the pores of the wood do not offer sufficient resistance and sweating or actual leakage occurs.

As an example may be cited a 3000 ft. pipe line supplying water to a modern power plant. Two-thirds its length, beginning from the intake end, lies on an even grade and is straight; the maximum hydrostatic head on this section is about 100 ft.; and the diameter of the pipe is 6 ft. The remainder of the pipe follows a heavy grade and, due to the increasing hydrostatic head throughout its length, necessarily falls outside of the limits of wood-stave pipe and is of steel. To have constructed the long section of steel would have required a thickness of at least 5/16 in. and to lessen the danger of collapse, this would probably have been made 3/8 in. Such a steel pipe would have cost, laid, about $16.50 per ft. A carefully selected and built wood-stave pipe was installed with 3 in. staves and round galvanized steel bands 5/8 in. in diameter. The spacing at the intake end is 10 in. and at the lower end, where the head is greatest it is 2 in. This pipe cost laid, $1.56 per linear ft. It should have a life of at least 10 years. The lower first cost is a vital item in the construction of a new plant, and in this case, where depreciation could not be greater than 10 per cent per annum, and good service is practically assured, it is good engineering practice to figure on replacement at least twice rather than employ the more costly steel construction.

The argument which holds good for large pipes under low pressures is even more applicable to small service pipes in town or city water works systems, and many small towns are enjoying a perfect water supply service using the wood machine-made pipe that could scarcely afford the cost of the same system with cast iron mains.

PERSONALS.

Thomas Mirk and K. G. Dunn, of Hunt, Mirk & Co., are in Southern California.

S. M. Kennedy of the Los Angeles Edison Electric Company, was at San Francisco this week.

J. W. Boyle, who is interested in electric railways at Utica, N. Y., was a San Francisco visitor last week.

Leon Bly, the secretary of the Tehama County Water & Power Company, is at San Francisco from Red Bluff, Cal.

Ben H. Maddox, of the Mt. Whitney Power Company at Visalia, Cal., was at San Francisco during the past week.

J. J. Davis, superintendent of the Santa Monica Light and Power Company, of Los Angeles, was a recent San Francisco visitor.

Morris Bien, a supervising engineer in the reclamation service of the United States government, was a recent arrival at San Francisco.

J. P. Poindexter, manager of the gas and electric lighting system of the Pacific Gas & Electric Company at Marysville, was at San Francisco during the past week.

R. E. Starkweather is building by contract the transmission and telephone line of the Mt. Konocti Light & Power Company from Hopland to Lakeport, Cal.

Wynn H. Meredith, Pacific Coast manager for Sanderson & Porter of New York, has returned to his San Francisco office from British Columbia, after an Eastern trip.

R. L. Yates, chief engineer with the Platt Iron Works, spent the past week at San Francisco with Chas. C. Moore & Co., Pacific Coast representatives of his company.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company of Chicago, has just returned to San Francisco after a tour of Oregon and Washington.

J. W. White, of the sales force of the Fort Wayne Electric Works, returned to San Francisco last Tuesday from an extensive tour of California and Nevada mining districts.

George I. Kinney, manager of the Pacific Coast offices of the Fort Wayne Electric Works, has returned to his San Francisco office after a tour of Oregon and Washington.

B. C. Condit, engineer for the Fleishhacker interests, is at Portland, Ore., in connection with their new hydroelectric transmission project in that territory. They are now in the market for two 5000-kw. generators.

C. L. Cory recently completed a valuation and a report to the Mayor and City Council of Berkeley on the plant of the Berkeley Electric Lighting Company in connection with the fixing of future rates for lighting.

W. S. Hanbridge left last Thursday on a ten days' tour of Southern California in the interests of the coming convention of California State Association of Electrical Contractors at Santa Catalina Island. He will visit Santa Barbara, Bakersfield, Los Angeles and San Diego, and other cities.

W. T. Brown, formerly with the Washington Water Power Company at Spokane, in conjunction with W. L. Hoffman and F. H. Godfrey, has opened offices as consulting electrical and mechanical engineer at Seattle, Tacoma and Vancouver, the Seattle office being in the Bailey Building and the Tacoma office in the Bank of California Building.

F. D. Weber, electrical inspector of the Underwriters' Equitable Rating Bureau, has been elected chairman of the Portland (Ore.), Section of the American Institute of Electrical Engineers, and H. R. Wakeman, engineer line department of the Portland Railway, Light & Power Company, secretary. L. B. Cramer, W. M. Hamilton and C. L. Wernicke make up the executive committee.

W. G. B. Euler, power-house superintendent of the Great Western Power Company, with headquarters at the Las Plumas plant, was at San Francisco last Tuesday.

A. Strauch, formerly with the General Electric Company's San Francisco office, has taken a position at the head of the new business department of the Mt. Whitney Power Company at Visalia.

Newly-elected members of the American Institute of Electrical Engineers include: E. L. Bettanier, electrician, Pasadena Municipal Light Department, Pasadena, Cal.; W. R. Birt, electrician, telegraph department, Southern Pacific Co., San Francisco, Cal.; R. E. Cunningham, superintendent electrical distribution, Southern California Edison Co., Los Angeles, Cal.; B. C. Edgar, assistant engineer, Southern Pacific Co., San Francisco, Cal.; W. F. Forward, wireman and repairman, Northern California Power Co., Manton, Cal.; F. H. Goodwin, electrical machinist Southern Pacific Co., Oakland, Cal.; J. A. Groninger, assistant chief electrician, Atchison, Topeka & Santa Fe Railroad, San Bernardino, Cal.; C. E. Kemper, engineer, Pacific Tel. & Tel. Co., Los Angeles, Cal.; L. M. Klauber new business department, San Diego Gas & Electric Co., San Diego, Cal.; R. B. Lawton, operator in charge, hydraulic generating station, Pacific Light & Power Corporation, Azusa, Cal.; C. W. B. Lindsey, electrical operator, Pacific Light & Power Corporation, Los Angeles, Cal.; O. G. F. Markhus, general manager, Idaho-Oregon Light & Power Co., Boise, Idaho; D. H. McAllister, assistant general superintendent of operation, Telluride Power Co., Provo, Utah; H. C. McCutchan, sales engineer, Holabird-Reynolds Elec. Co., Los Angeles, Cal.; E. R. Pease, draftsman, Western Canada Power Co., Vancouver, B. C.; W. H. Trenner, superintendent, Idaho-Oregon Light & Power Co., Boise, Idaho; C. M. Warnecke, assistant electrical engineer, Pacific Electric Co., Los Angeles, Cal.; E. G. Wedgwood, electrician, Sacramento Valley Power Co., Chico, Cal.; G. W. Welsh, assistant engineer, electrical department, Southern Pacific Co., San Francisco, Cal.

TRADE NOTES.

M. C. Baker & Son have moved their electric shop from 61 Second street to more commodious quarters at 78 Second street, San Francisco.

The annual conference of Pacific Coast salesmen and supply agents of the General Electric Co. was held at San Francisco this week, several Eastern heads of departments attending.

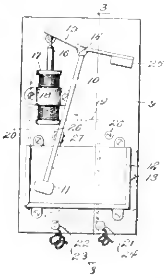
The Colonial Electrical Agency of San Francisco, agents for the Colonial Electric Company and the Economy Electric Company, incandescent lamp manufacturers, has removed from 576 Mission street, to the Board of Public Trade Building, 444 Market street.

O. K Brown, secretary of the Treasure Gold Mining Company, Pacific Building, San Francisco, has shipped a quantity of electrical equipment, purchased from Fairbanks, Morse & Co. to their mine and works at Hornitos, Cal. Current will be purchased from the San Joaquin Light and Power Corporation. A 15-h.p. motor will be installed to operate five additional stamps in the mill, a 40-h.p. motor to drive an air-compressor and a 6-h.p. motor for the concentrator.

The General Electric Company has closed a contract with the United States Government for three steam turbines for the Bureau of Yards and Docks for use in connection with the government drydock at Pearl Harbor, Hawaiian Islands. This aparatus is rated as follows: One A. T. B. 2, 1000-kw., 3600 r.p.m., 2300-v., horizontal Curtis turbine; one A. T. B. 2, 500-kw., 3600 r.p.m., 2300-v., horizontal Curtis turbine; one C. C. 2, 35-kw., 3600 r.p.m., 125-v., D. C. turbine exciter set.

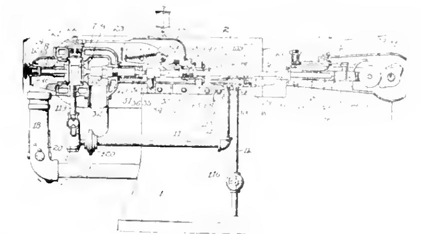
PATENTS

994,712. Electrical Indicator. Edward W. Bishop, Bakersfield, Cal. In an indicating device of the class described, the combination of a support, a swinging element mounted thereon, a position-indicating means located behind the free end of the element and over which the latter moves, an electrical device responsive to current for moving the element



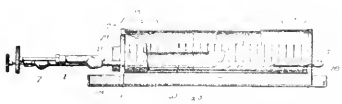
from its normal position, means for opposing the movement of the element and returning the latter to normal position when the said device is de-energized, a trough disposed behind the said position indicating means, and a member rigid on the element and extending into the trough for retarding the movement of the element.

995,062. Gas-Engine. Otho C. Duryea and Morris C. White, Los Angeles, Cal., assignors to Duryea-White Machinery Company, Los Angeles, Cal. A cylinder, a piston therein, a shaft, mechanism co-operating with the piston for driving



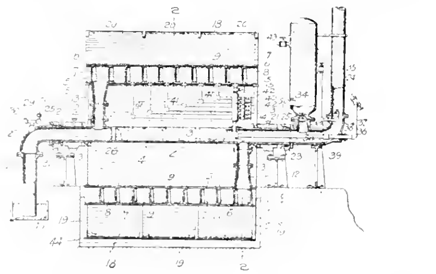
said shaft, valves, cams and a longitudinally and pivotally movable bar operated by said shaft for controlling said vales and thereby causing the piston to operate by internal combustion in said cylinder or by fluid pressure.

995,362. Oil-Gas Generator and Burner. Ezra P. Magoon, Los Angeles, Cal., assignor to Blue Flame Distillate Burner Company, Los Angeles, Cal. An oil burner comprising a generator formed with two horizontal members, a cross tube connecting said members at one end, an oil inlet connection at the other end of one of said members, an outlet connection at the corresponding end of the other of said members, a burner chamber, extending longitudinally



between said horizontal members, consisting of a tubular body with a series of vertical outlet openings in each side, end plates for said tubular body, the forward end plate being perforated and having a hollow extension projecting laterally into said tubular body forming a mixing chamber, the walls of said perforation converging rearwardly into said mixing chamber forming an air and gas inlet into said mixing chamber, said mixing having a discharge outlet in the top thereof at its inner end.

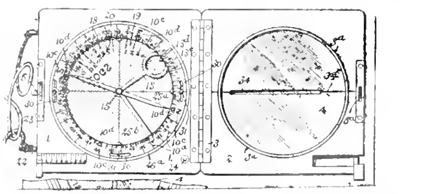
995,112. Water-Lift and Air-Compressor. Ransom Y. Bovee, Denver, Colo., assignor to Hydro Engine, Power & Irrigation Company, Denver, Colo. A device of the class named comprising a helicoidal conduit rotative about a horizontal axis, a suction pipe communicating with one of its ends, a stand-pipe communicating with the opposite end of



the conduit, an air reservoir having an inlet interposed between the conduit and the stand pipe, whereby the air leaving the conduit with the fluid, may be separated therefrom before the latter reaches the stand pipe, and valve controlled pipes respectively connecting the various convolutions comprised in said conduit, with said reservoir.

994,957. Magnetic Vibrator. Frank V. Smith, Floriston, Cal. In a device of the class described, an electro-magnet; plates applied to opposite ends of the magnet; a cover resting upon one of said plates; securing devices uniting the plates and the cover; a holder reciprocating in the plates and in the cover; an armature upon the holder beneath the cover; a spring bearing at one end upon the cover; and a device upon the holder for engaging the other end of the spring to adjust the tension thereof.

994,901. Surveying and Cruising Instrument. Joseph Barrow, Portland, Ore. A surveying instrument that comprises a compass box, a compass needle mounted in said box, a scale plate co-operating with said compass needle and having the cardinal points provided with indicating letters "N"—"S"—"E" and "W", said scale plate having letters graduated on the same at the north, south, east and west letters to accentuate the indication of the north,



south, east and west positions, a second scale plate carried by said box beneath said compass needle and having graduated on the same a due north and south and a due east and west line, a lid hinged to said box, a mirror carried by said lid to reflect said compass needle and said scales when said lid is tilted up at an angle to the plane of said box, said lid having a line thereon according to the north and south line of said second scale plate.

INDUSTRIAL

SINGLE-PHASE AND POLYPHASE POWER-FACTOR METERS.

The modern tendency in the operation of large systems is to regulate the power-factor of the load by over-exciting synchronous machines, and wherever such regulation is attempted accurate knowledge of the value of the power-factor is highly desirable.

Fig. 1. Power Factor Meter.

One type of power-factor meter is based on the electro-dynamometer principle. It consists of a fixed field coil and two movable coils mounted in space quadrature on the same staff. The fixed or field coil is connected in series with the line and the movable coils are connected in shunt therewith. When used on polyphase circuits each coil is connected to a separate phase while used on single-phase circuits a phase-splitting device is employed.

When the current in one of the movable coils is in phase with that in the fixed coil, the movable system will turn until the fields due to these currents coincide. If the field due to the current in the fixed coil reaches its maximum at a time intermediate between the time of maximum of the currents in either of the movable coils, then the movable system takes up a position such that the resultant field of the two coils, which coincides in time-phase with the fixed field will also coincide in space position with it.

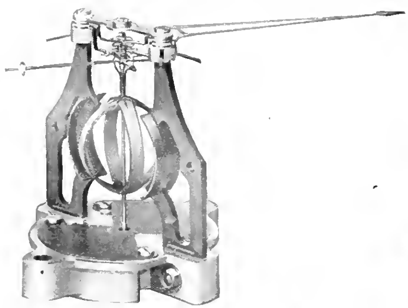


Fig. 2. Power Factor Meter Movement.

The accuracy and general usefulness of a power-factor meter of this type depend first of all upon the construction of the movable coils. If these coils are to perform properly their functions they must be of identical shape and size and they must be rigidly maintained in planes which bisect

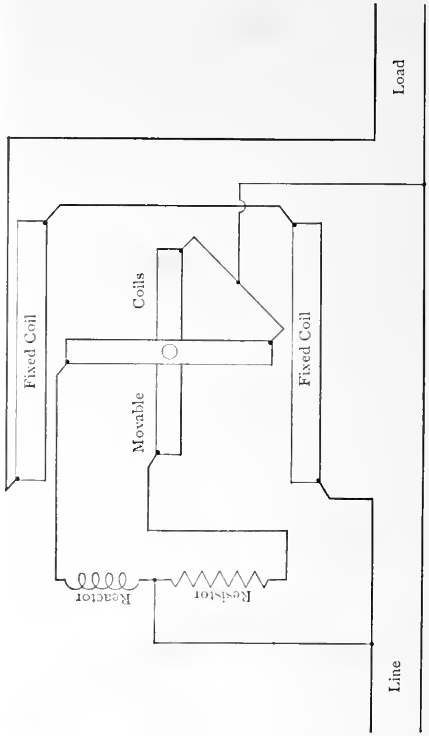


Fig. 3. Circuit Diagram Single Phase Power Factor Meter.

each other at right angles; that is, the coils must cross at right angles and pass bodily through each other. These seemingly impossible conditions have been met for the first time in a new form of power-factor meter recently placed on the market by the Weston Electrical Instrument Company of Newark, N. J. In this new instrument the coils are wound simultaneously on a special machine. They are interlaced layer by layer at diametral crossing points and an opening

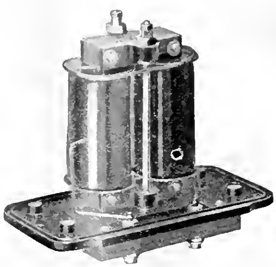


Fig. 4. Reactor.

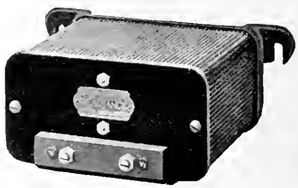


Fig. 5. Auxiliary Box.

is left through which the staff may pass. The complete coils, which now resemble the famous Siamese twins, are treated with a special cement that binds the turns together like a single piece of metal, and thin tiny curved plates drilled to fit the staff are cemented over the inside surface of the

crossing points. These plates serve to center accurately the coil system and tiny pins which pass through the staff and engage ears on the plates hold it in a definite axial position.

Therefore the movable coils occupy a perfectly definite and permanent position with reference to each other and to the rest of the system such as is necessary to the production of a high degree of accuracy and reliability.

The electrodynamometer type of power-factor meter offers a serious difficulty in that the movable system must be electrically connected to the external circuit and yet this connection dare not offer any appreciable torsional effect to oppose the motion of the system. The spirals used in this new power-factor meter are extremely delicate affairs; they are just strong enough to be self-sustaining and yet not exert any appreciable torque. For instance, 16,000 of these tiny spirals weigh only 1 ounce and the error due to their torsional moment is only 1 per cent at 1/5 load.

When used on single-phase circuits a phase-splitting device is required and the reactor has to be specially designed for this class of work if anything like accurate results are to be expected. The reactor used with the single-phase power-factor meter is shown in Fig. 4 and is similar in its mechanical construction to those used with the frequency meter which were described in a previous issue. This power-factor meter has the distinction of being the first instrument of this type, which can be used on single-phase circuits without sacrifice of accuracy.

STOCKTON FIRE ENAMEL BRICK PLANT.

The plant of the Stockton Fire Enamel Brick Company, which makes a specialty of glazed and malt glazed bricks, is situated on the outskirts of Stockton on the Southern Pacific and Western Pacific Railroads. Two spur tracks about 1000 feet long, run from the Southern Pacific line to the works, the raw material being brought in on one track, and the finished product sent out on the other.

The clay, which is the finest obtainable in California, is brought from Lincoln, Placer county, about 70 miles distant. It is dumped from the cars and then shoveled into a dry pan, belt driven by a 35 h.p. motor of the squirrel cage type, where the clay is ground up fine and then drops through a screen in the bottom of the dry pan and is caught up by a cup elevator driven by a 5 h.p. General Electric induction motor and carried to top of building and dropped onto a screen, through which it passes into a number of bins placed about 20 feet below. From these bins the ground clay is conducted through a pipe to the pug mill, where it is mixed with water and sand in such proportions as to give it the right consistency. The pug mill is driven by a 25 h.p. induction motor. From the pug mill the mixture passes by gravity down a chute into the brick machine on the ground floor. A 75 h.p. induction motor drives the brick machine. The compressed clay is conveyed from the brick machine by a belt to an automatic cutting table where the clay is cut to the requisite size for bricks. These bricks are then conveyed to another department where they are dipped in the glazing solution, and then either taken to a drying room, or allowed to dry in the sun. After being dried they are again dipped in the glazing solution, after which they are taken to the kiln to be burned. The bricks are then ready for shipment.

It is interesting to note that the bricks require only one burning, unlike otner factories on the Coast, which have to give two burnings. The special glazing which this company uses, makes it necessary to burn the bricks but once. Each of the four kilns has a capacity of 60,000 bricks, and is heated by means of oil to a maximum temperature of about 2000 degrees F.

Power is taken from the Pacific Gas & Electric Co., at 2000 volts, 3-phase, 60 cycles, and transformed down to 3-phase, 440 volts by means of three 20 kw. oil cooled transformers. These transformers take care of the average load (60 h.p.) easily, and if the maximum horsepower capacity of the plant (150 h.p.) is used—which occurs very rarely—the transformers must carry an overload.

The plant has been in operation for six years, and during that time the only repairs to the motors have been the replacement of new bearings and a few minor adjustments. All of the electrical machinery is of General Electric manufacture, and the brick and clay machinery was made by the American Clay Machinery Company. The installation of the electrical apparatus was made by the Electrical Engineering & Supply Company, Stockton, Cal.

COLUMBIA AND PUGET SOUND RAILROAD ADOPTS THE TELEPHONE.

The Columbia and Puget Sound has joined the ranks of the railroads which favor the telephone method of dispatching trains, and has ordered from the Western Electric Company at Seattle selectors and associated telephone apparatus for a circuit about thirty miles in length.

The dispatcher for this line will be located at Seattle. Way station telephone equipments will be installed at Indian, Argo, Black River, Maple Valley and Renton. The line will be constructed of No. 10 gauge hard drawn copper wire.

The railway telephone has gained a strong foothold in the northwest, where it is replacing the long-established telegraph for handling train movements on a large number of the more important roads, including the Canadian Pacific, Chicago, Milwaukee & Puget Sound, Great Northern, Northern Pacific, Oregon Short Line and the Spokane, Portland & Seattle.

ELECTRIC POWER INSTALLATION OF THE SANTA ROSA MINING COMPANY.

The Santa Rosa Mining Company, a subsidiary of the Exploration Company of England and Mexico, located in the State of Zacetecas, Mexico, near Concepcion del Oro, has received and is erecting most of the machinery that will enter into the equipment of its mill.

Electric light and power is supplied to the property from a gas producer plant in which anthracite coal or charcoal is used as fuel. The gas engine will be connected by a belt to a 150 kw. Westinghouse a.c. generator. Switchboards, transformers, etc., and 20 motors have been installed. The entire equipment is very complete. The tube mill is driven by a 60 h.p. motor; there are seven motor-driven direct connected pumps for supplying water to the cyanide plant, and nine other motors are located at various places around the plant.

A transmission line about two miles long supplies the current to three motor-driven pumps, which control the water supply.

All of the equipment has been purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., of Mexico City, which has furnished Westinghouse equipment throughout. The motors are of a new type which the Westinghouse Company has brought out for especially heavy duty service. When completed, this property will have one of the most modern equipments in Mexico.

NEW CATALOGUES.

Catalogue No. 50 from the Brookfield Glass Company effectively portrays and describes their complete line of screw glass insulators and knobs for all purposes.

Economical Steam Production presents the principles of soot cleaning as applied to all types of water tube and return tubular boilers by means of the Vulcan soot cleaner, sold by G. L. Simonds & Co., 801 Steinway Building, Chicago, Ill.

NEWS NOTES

FINANCIAL.

NORTH YAKIMA, WASH.—North Yakima proposes to construct a municipal power plant to cost $250,000. This is to be financed by sale of fifty-year bonds.

CONNELL, WASH.—Four million dollars will be expended by the Washington Water Power Company of Spokane in building its electric power plant at Long Lake, 23 miles north of the city.

SUMAS, WASH.—An ordinance of the town of Sumas providing for the establishment and maintenance of an electric lighting, heating and power system, has been passed. Bonds to the amount of $7000 will be issued.

OAKLAND, CAL.—The growth of business on the lines of the Oakland Traction Company is shown by the following comparative statement of gross earnings: 1902, $945,000; 1905, $1,441,000; 1906, $2,218,000; 1907, $2,515,000; 1908, $2,771,000; 1910, $2,934,000.

SANTA BARBARA, CAL.—The City Council has awarded $40,000 worth of 4 per cent city water tunnel bonds to the Santa Barbara County National Bank at accrued interest and a premium of $233.50. Other bids were: Santa Barbara Savings and Loan Bank, $203; William R. Statts of Pasadena, $56, and E. G. Blymer of San Francisco, $12.50.

TENINO, WASH.—The entire holdings and franchise of the Tenino Light & Power Company have been purchased by the Washington-Oregon Corporation, which is reported to be a subsidiary corporation of the O. R. & N. Co. The purchasing company will at once construct a power plant on the Skookumchuck river to furnish electricity to the Hercules Sandstone Company.

PORTLAND, ORE.—The results of operations of the Portland (Ore.) Railway, Light & Power Company in 1909 and 1910 follow:

	1909	1910
Gross receipts	$4,818,022	$5,638,895
Operating expenses	2,196,496	2,444,178
Net earnings	$2,621,526	$3,194,717
Fixed charges	1,493,039	1,678,228
Surplus	$1,128,487	$1,516,489
Per cent of operating expenses	45.6	43.3

B. S. Josselyn, the president, says that the increase in gross earnings in 1910 over 1909 was $820,873, or 17 per cent. The increase in net earnings was $573,191, or 21.9 per cent. Thirteen and one-half miles of single track were constructed and 22½ miles reconstructed, the reconstruction being caused mainly by the paving of streets occupied by tracks. The total cost of track construction and reconstruction was $1,006,710, of which $785,069 was charged to capital account. There are 250.93 miles of single track in the system. Eighty-two new passenger cars, thirty-four freight and work cars were purchased, and six passenger cars, one mail and express car and three locomotives were built in the company's shops, at a total cost of $642,663. The present equipment consists of 568 passenger cars, 352 freight and work cars and eight electric locomotives. Three car barns with storage capacity for 115 cars were completed. The nine-story office building in Portland was completed.

SAN FRANCISCO, CAL.—The United Railroads Company and its holding company, the United Railroads Investment Company, of New Jersey, have issued annual reports for the year 1910. The report of the latter corporation shows that it holds all of the $5,000,000 of first preferred stock of the local street railway combine, all of its $20,000,000 of preferred stock, $8,801,400 of its $20,000,000 of common stock and guarantees its outstanding $400,000 of equipment notes. The latter and the first-preferred stock were issued by the United Railroads Company after the disaster of 1906. The local street railway combine earned a surplus of $601,907 last year, as against $404,470 in 1909. For the year 1910 its gross earnings amounted to $7,653,489; net earnings, $2,924,219; other income, $90,279. Fixed charges were $2,412,509. Gross earnings were $197,524 greater than in 1909, while the surplus increased $197,437 over the preceding year. The New Jersey holding company, in addition to owning United Railroads Company stocks, owns most of the stock of the Philadelphia company of Pittsburg, which has street railway and gas and electric properties in that city and several towns close by. The holding company had a surplus of $766,467 in 1910, against $512,350 the year before. Its receipts in 1910 were $2,044,672 from dividends on stocks and $64,889 of other income. Its expenses amounted to $75,124, and it paid $1,268,070 as interest on bonds.

INCORPORATIONS.

OXNARD, CAL.—Herbert Hedges and S. S. Bradley will open an electrical supply business at 105 Fifth street, under the title of Hedges-Bradley Electrical Company.

EUREKA, MONT.—The Tobacco Valley Telephone Company has been organized to furnish service to Gateway, Rexford, Fortine and Trego. P. N. Benard is president.

BOISE, IDAHO.—Articles have been filed for the Boise-Council-Landore Railroad. Preliminary surveys have already been made for this line, which is to be an electric road from Council through the rich fruit belt of Adams county. The incorporators are: John M. Haines of the Pierce real estate firm, E. W. Bowman, J. D. S. Manville, Harry Wyman and Geo. Huebener. The capital stock is $2,000,000.

OAKLAND, CAL.—Articles of incorporation of the Oakland Natural Gas Company have been filed with the county clerk. The company is capitalized at $300,000, with shares at $1 each. The directors are: C. W. Porter, S. L. Klarnet, J. E. Cofer, T. T. McMahon and N. B. Myran. It was announced by Porter, who is president, that C. L. Cofer of Red Bluff has located natural gas sources within the city limits of Oakland.

ILLUMINATION.

ELKO, NEV.—The Board of Commissioners has granted the Deeth Mercantile Company a franchise to light the town of Deeth with electricity.

MOUNTAIN HOME, IDAHO.—The Council has granted to L. L. Nunn & Co. the right to enter the city with a line for furnishing light and power.

FRESNO, CAL.—According to a statement by Manager A. G. Wishon of the San Joaquin Light and Power Company, the price of electric lights in all the larger cities and towns from Merced on the north to Bakersfield on the south, and including Fresno, will be 8 cents per kilowatt-hour after November 1 next.

SAN DIEGO, CAL.—The San Diego Consolidated Electric Company is soliciting subscribers in National City and Chula Vista and will soon have gas piped in the district for lighting and cooking.

MARYSVILLE, CAL.—The supervisors have granted Hetz & Berg, electricians of Marysville, permission to erect poles and string wires for an electric lighting system in Live Oak and adjacent highways.

WILLOWS, CAL.—The gas plant will be in operation in a few days. Van E. Britton, the Northern California Power Company engineer in charge of the construction of the plant here, says gas will be ready for consumption this week.

SUSANVILLE, CAL.—James Branham made application to the Board of Trustees for a franchise for a period of 50 years, to erect and maintain poles and wires for the transmission of electricity for heat, power and lighting along the streets and alleys of Susanville.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company has contracted with the National Briquetting & Clay Working Machinery Company to repair a compound Corliss gas compressor at the gas works at the corner of Center and Ducommon streets for $3000.

NEWPORT, CAL.—Morris Wygant has received notice from the General Land Office, Washington, that he has been awarded the contract for a survey of a hydroelectric power site and canal at the Siletz Agency. The estimated cost of the proposed plant is $250,000.

SAN LUIS OBISPO, CAL.—R. E. Easton has made application to the Board of Supervisors of the county of San Luis Obispo, for a franchise for a period of 50 years, to furnish the inhabitants of the county, with natural and artificial gas for lights, heat, fuel and power.

LOS ANGELES, CAL.—The Supervisors have granted to the Southern California Gas Corporation a 40-year gas franchise, covering the greater portion of the county. The price paid was $100. The franchise covers a territory running east of the city to Pomona and west to a line even with Redondo Beach.

TRANSMISSION.

NORTH YAKIMA, WASH.—This place will decide July 1 on a $300,000 bond issue for construction of a municipal power plant.

HERMISTON, ORE.—The Hermiston Light & Power Company will erect a concrete dam to replace the temporary one now in use.

AUBURN, CAL.—The Supervisors have granted a franchise to the Great Western Power Company to erect a pole line along the highways of Placer County.

DAYTON, WASH.—The Pacific Power & Light Company has been granted a 50-year franchise for the construction of a power line along the old Lewiston road.

OAKLAND, ORE.—This place recently voted $15,000 in bonds with which to establish a light and power plant and to cancel the floating indebtedness of the city.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has made application to the Boaro of Supervisors for a franchise to erect poles and wires for the transmission of light and power on all public highways in the county for a term of fifty years.

YREKA, CAL.—Preliminary work for the construction of the dam across the Klamath river by the Siskiyou Electric Power & Light Company has been commenced. The dam is about seven miles down the river from Klamath Hot Springs. A large power plant will be built near the dam for the generation of electricity.

MARE ISLAND NAVY YARD, CAL.—Bids will be received at the bureau of yards and docks, navy department, up to July 8 for auxiliary power plant equipment at this yard.

WALLA WALLA, WASH.—Franchise has been granted the Pacific Power & Light Company for a transmission line from this place to Columbia county line. Construction work will begin at once.

EUGENE, ORE.—The Oregon Power Company is completing its transmission line from the Albany substation to Brownsville, Oregon. J. L. Lambirth, of Eugene, is superintendent of constrnction.

GUSTINE, CAL.—The Pacific Gas & Electric Company has withdrawn from this field, and the San Joaquin Light & Power Company announces that this company's line will be extended to Gustine. J. A. Berryman is representing the latter company.

TRANSPORTATION.

OLYMPIA, WASH.—Dr. P. H Carlyon has been granted a franchise by the City Council for the construction of a belt line railway around tne Carlyon fill on the waterfront.

SANTA MONICA, CAL.—The City Clerk will receive sealed bids up to July 10 for the purchase of a franchise to operate for a period of 40 years a street railway in this place.

BURLEY, IDAHO.—Reports are to the effect that Chicago capitalists have disposed of bonds for the construction of an electric railway from Burley to Albion, and that the owners will soon arrive here to start construction work.

LOS ANGELES, CAL.—Final surveys are being made and material assembled for the electric railway to be built between Los Angeles and Redondo for the Moneta avenue line and for the Long Beach line of the Pacific Electric Railway Company.

SANTA CLARA, CAL.—The Peninsular Railroad Company has applied for a franchise for a single or double track electric railroad on Saratoga avenue, Bellomy street, Lincoln street, Franklin street and Jefferson street to connect with the present electric railroad here.

LOS ANGELES, CAL.—The request of the Los Angeles-Pacific Railway Company for permission to electrify the old Santa Monica steam line of the Southern Pacific Company from Clemente Junction to the west city limits, has been referred to the Board of Public Utilities.

CHICO, CAL.—The Northern Electric Railway has been granted a 50-year franchise for a double track on Main street and will surrender its present franchise known as the "Clough franchise." Officials of the company state that the work of laying the double track will begin within a few days.

FRESNO, CAL.—The graders who are at work on the Fresno, Hanford & Summit Lake road are at last headed toward Fresno. The ordinance granting a franchise to the road through Fowler passed its final reading this week and gave to the road a franchise along one street through the town.

OAKLAND, CAL.—Plans for improvements that will double the capacity of the Key Route lines through Oakland and Berkeley are nearly completed. In addition to converting the Key Route pier into a solid mole it is proposed to enlarge the ferry depot and slips at the end of the mole and to carry all trains through the depot on a series of loops. The loop is to be constructed on a solid foundation of earth and concrete, instead of upon piling. The loop system, it is claimed, will greatly facilitate the handling of passengers, and will shorten the running time of trains.

OAKLAND, CAL.—The City Council has passed an ordinance granting to the Oakland and Bay Shore Railroad Company a franchise for the period of 35 years, to construct and maintain railroad tracks of standard gauge together with all necessary switches and crossings in certain parts of the city of Oakland.

SAN FRANCISCO, CAL.—Ernest Thalmann, the New York banker; Patrick Calhoun and their associates have just completed arrangements for the sale of $1,000,000 of the bonds of the Sierra and San Francisco Power Company, to complete its electric generating plant on the Stanislaus River, together with its distributing system.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has contracted with Chas. W. Corbaly to construct and complete a single track pile trestle bridge over Verdugo Wash., on the railway line known as the Glendale-Burbank line at $0.435 per lin. ft. for placing pile in trestle below cut off, and $35.75 per 1000 ft. board measure for lumber.

LOS ANGELES, CAL.—About $550,000 is being expended by the Pacific Electric Company for the immediate improvement of its service. The company will place about 85 additional cars in operation in July and has just purchased motor generator sets for substations at Pasadena, Redondo, Del Rey, Vineyards and other points. The cost of equipment will be about $150,000.

TELEPHONE AND TELEGRAPH.

WALLACE, IDAHO.—The North Idaho Telephone Company announces that work will commence at once on construction of a line for the completion of circuit between Murray and Nelson siding.

SAN FRANCISCO, CAL.—The telephone rates bill has been passed to print by the unanimous vote of the Supervisors. It makes no change in the charges to the public, but reduces slightly the expense to hotels of wall phone extensions in the private rooms.

LOS ANGELES, CAL.—The Board of Public Utilities have fixed the phone rates and have increased the residence charge on the Home Company's phones to $2.50 and reduced the Pacific Company's charges for residence phones to $2.50. Business service has been reduced from $6 to $5.75. It is expected that these rates will stand.

WATERWORKS.

SEWARD, ALASKA.—The City Council at Prince Rupert is planning to build waterworks and sewers to cost $600,000.

SAN LUIS OBISPO, CAL.—Sealed bids are being received by the Clerk of the Board of Trustees for furnishing water pipe and fittings in accordance with specifications.

COEUR d ALENE, IDAHO.—The County Commissioners have granted to the Bayview Townsite and Water Company the right to establish waterworks and system in this county.

ALTURAS, CAL.—The town of Alturas has advertised for bids for sinking and casing two wells each ten inches in diameter, as part of the public water system to be installed here.

SAN DIEGO, CAL.—A centrifugal pump, which lifts 10,000 gallons a minute will be installed at the end of the 10 inch main at La Jolla to relieve a threatened water famine there.

LOS ANGELES, CAL.—The Board of Public Works will receive sealed bids up to June 30, for furnishing three 14 inch gate valves, six 16 inch gate valves, nine 18 inch gate valves, two 24 inch gate valves and five 26 inch gate valves to the city.

HELENA, MONT.—An election is to be held here on the 26th of June for the purpose of submitting to taxpayers the question of issuing $400,000 bonds for the purpose of acquiring a water plant.

LEWISTON, IDAHO.—The City Council has authorized the city comptroller to issue a call for bids for supplying the city with 1275 ft. of 4-in. pipe to be used in extending the water system service.

LOS ANGELES, CAL.—The Board of Public Service Commissioners will receive sealed bids up to June 13 for furnishing cast iron water pipe and fittings to the Department of Public Service of the city.

SACRAMENTO, CAL.—Bids will be received at the office of the clerk of the trustees, up to July 19th, 1911, for 30 dozen three-quarter inch water taps for the water department. The taps must weigh finished 42 ounces.

SAN LUIS OBISPO, CAL.—The bids of contractors Payne & Deacon for the construction of the new water pipe line, the building of the concrete dam and the sand box have been rejected by the city council and the work has been ordered done by the Department of Public Works.

SEATTLE, WASH.—The Council has passed an ordinance providing for the improvement of a portion of Twenty-sixth avenue Northwest and Twenty-seventh avenue Northwest, by the construction of water mains according to plans filed in the office of the Department of Public Works.

PORTERVILLE, CAL.—Plans and specifications have been drawn up by the city engineer for the extension of the mains of the water system. It is estimated that the work of completing the system will cost in the neighborhood of $50,000, making almost $200,000 which has been spent by the city since the municipal ownership of the plant was completed.

DUNSMUIR, CAL.—The Dunsmuir Water, Power & Light Company will begin work improving the system before the end of the month. A new 12 inch pipe will be laid from Mossbrae Falls to Dunsmuir. This will cost $75,000. The pipe will be 18 inches in diameter at the falls and in the course of a mile will taper to 12 inches. A force of from 75 to 100 men will be employed.

ELMA, WASH.—The bid of the Algrace Company of Seattle, for $10,000 of Elma water bonds has been accepted by the council, which has decided to lay an 8-in. wood pipe from the Wenzell springs to 5th street, a 10-in. iron pipe from that point through Main and Third streets to the railway track and a 2-in. wood pipe from that point to the reservoir. Mr. L. Louis Kelsey of Portland is the engineer in charge of the water works.

SANTA FE, N. M.—Adjutant General S. S. Brooks has awarded contracts to supply a water system for the target range at Las Vegas where the National Guard will hold its encampment this summer and which is three miles from any water. A contract for a 15,000 gallon steel tank was awarded to the Des Moines Brick and Iron Company of Des Moines, Iowa. The contract for the pump and motor house and for laying pipe was given to F. J. Gehring of Las Vegas.

OAKLAND, CAL.—The Sierra-Blue Lakes Water Company, of which Eugene Sullivan of San Francisco is president, is awaiting the decision of the new commission relative to the proposed acquirement of a municipal plant. The company has made an offer in the form of a letter to Councilman Wm. J. Baccus. A supply of 60,000,000 gallons a day is promised for an expenditure of $20,000,000. The plan includes a watershed in Calaveras, Alpine and Amador counties of 534 square miles, a reservoir of a capacity of fifty billion gallons and conditions available for an electric power plant which, it is claimed, will produce 50,000 h.p. without extra cost. The same offer has been made to Berkeley.